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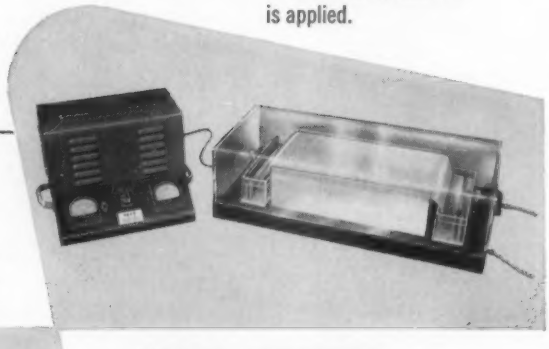

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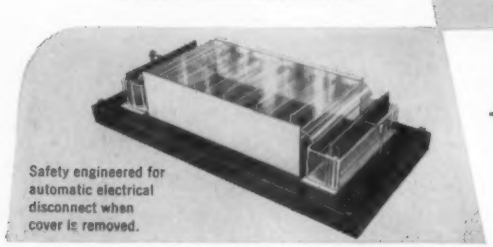

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Science for Its Own Sake[1]

Presidential Address to the British Association for the Advancement of Science

Sir Edward Appleton

Principal and Vice-Chancellor, University of Edinburgh, Edinburgh, Scotland

IN EXPRESSING MY WARM APPRECIATION of the signal honour of being elected the Association's President, I would like to add how particularly agreeable the occasion is made for me by the fact that our Meeting this year takes place in Liverpool. In my younger days all my journeys by sea began at Liverpool which thereby came to represent for me a gateway to adventure; and something of the old magic still remains.

Now, although our Association met four times in Liverpool before the University was founded, in the two succeeding Liverpool Meetings the University has joined with the City in welcoming our members and organising much of our week's activity. Our reception by Town and Gown has been, on this present occasion, notably graceful and gracious, and I would like to tell both the Lord Mayor and the Vice-Chancellor how touched we have been by the cordial expression of their greetings and good wishes.

There is, I think, something very appropriate in our meeting here in Liverpool, a city whose interests and history have been so long and so closely bound up with the advancement of science. This happy conjunction has been remarked on by several of my predecessors and has been a fruitful source of inspiration to them. I have noticed, on looking through their Addresses, how often their thoughts have turned towards the practical achievements of science and how often they have been able to cite their instances from Liverpool itself. It is interesting to note, too, how the city has served, through successive meetings, to point the direction which science was to take. The great developments that were noticed here by the Earl of Burlington at the first Liverpool Meeting in 1837 were an indication of many things to come in other parts of the country before the turn of the century. Indeed, one might say that what was true of Liverpool at one British Association Meeting was true of the rest of Britain at the next, and of most of the world by the one after that.

I confess that I stand somewhat in awe of my distinguished predecessors, who were inspired by this setting to range so widely over the fields of scientific progress in their own day. To succeed to an office which has been held here in Liverpool by such men as Rutherford and Lister and Huxley can be no easy task. It is not only the abilities of these men which now appear so outstanding. What has particularly struck me, on reading their words, is the story of solid achievement each had to relate in speaking of recent scientific progress. "The heroic age of physical science" Rutherford appropriately calls the period that saw the first investigations of the radioactive elements, the discovery of x-rays and the development of wireless telegraphy. And, again speaking of the period between the two Liverpool Meetings of 1896 and 1923, he remarks "the epoch has been an age of experiment when the experimenter has been the pioneer in the attack on new problems. At the same time, it has also been an age of bold ideas in theory, as the Quantum Theory or the Theory of Relativity so well illustrate." Joseph Lister, at an earlier meeting, dwelt in his Address on the same conjunction of experiment and theory, and how their application in the field of medicine had led, in his own time, to the ever-memorable discoveries of anesthetics and antiseptic surgery. A similar sense of substantial achievement is conveyed in the words of T. H. Huxley. Devoting himself to a theoretical account of the genesis of bacteria, he nevertheless pauses in it to estimate that the practical application of the theory, in the French silk-worm industry and wine trade alone, had—to quote his own words—"repaired the money losses caused by the frightful and calamitous war of this autumn"—he was speaking in 1870. In Huxley's remarks, indeed, I seem to detect a certain diffidence about entering the realm of pure theory at all, for, after apologising to his audience for the dreariness of the theoretical approach to his subject, he continues: "Nevertheless you will have observed that before we had traveled very far upon our road, there appeared, on the right hand and on the left, fields laden with a harvest of golden grain, immediately convertible into those things which the most sordidly practical of men will admit to have value—namely, money and life."

What my predecessors had to tell was indeed a story of outstanding achievement. And yet what those great men had to say about the benefits of science can surely be equalled, if not surpassed, in our own day. It is true that nowadays we are more sharply aware of the debit, as well as the credit, side of our accounts with science, as my predecessor, Professor A. V. Hill, reminded us last year. But no one could doubt that the material benefits of science are there, and, indeed, are

[1] Reprinted with permission from *The Advancement of Science*, No. 38, Sept. 1953.

with us in our daily lives to an extent which even the 19th century could scarcely have expected.

Now the subject of my address, "Science for its own Sake," is already known to you. It was chosen to emphasise something that, at times, is in danger of being overlooked, namely, that science has interest as well as utility—that science is illuminating as well as fruitful. Having spent ten years of my own life in seeking to further the applications of science in the practical life of our country, I do not think I can be accused of under-estimating the vital importance of science as an instrument of material utility. I have long held the belief that the cost of scientific research is the price we must pay for our industrial progress. But we should be misleading the public, as well as ourselves, if we based our case for the general support of the pursuit of science on its utilitarian aspects alone. I know that we can claim that many discoveries in pure science, which in their time had no obviously practical import, have later proved to be the foundations of major improvements in our material civilisation. But even that is an argument of profit and loss, and, to my mind, does not bring us entirely to the heart of the matter. I should like to go back beyond the achievements, to the example of the scientist—be he amateur or professional—who is impelled solely by a passionate desire to explore and understand. That is what I mean by science for its own sake—when knowledge and insight are sufficient reward in themselves. Can the pursuit of a scientific vocation of this kind be a way of living worthily? Can it, in Dr. Johnson's phrase, help to advance us in the dignity of thinking beings? What values for us as individuals does it propound? As well as theoretical knowledge, as well as material benefit, is there some deeper, if more intangible, thing, even wisdom itself, to be found in our vocation?

I certainly make no claim to be able to provide the right, or the only, answers to such questions. At the most I simply hope to indicate to you where I think *some* of the value of a scientific vocation lies. After the extravagant claims that have sometimes been made on behalf of science—claims which have had the disagreeable consequence of putting the scientist on a pedestal—it is well that we should walk humbly. And yet, all the same, in a time of uncertainty of values and lowering of ideals, it is important that we should own to what we believe.

Now I begin by attempting to get the setting right, by pointing out that we scientists do not really inhabit the kind of universe which has sometimes been attributed to us. Science has so often been accused of having reduced the beauty and mystery of the universe to something cold and mechanical. When science enters the door, enchantment, it has been said, flies out of the window. You will remember the lines of the poet Keats:

> There was an awful rainbow once in heaven:
> We know her woof, her texture; she is given
> In the dull catalogue of common things.

Now it is fairly easy to see how this attitude came about. The world of what is now called classical physics, as it was mapped out for us from the time of Newton onwards, had the advantage of appearing comfortably solid and tangibly final. Anyone, it seemed, who could understand why an apple falls from a tree could also understand the stars in their courses. In this light the universe might well seem to a poet to fail to come up to his expectations. We now know how misleading it was to regard this account of the matter as final. Perhaps the most striking fact about modern science, in its explorations ranging from the heart of the atom to the frontiers of the universe, is that, like poetry, like philosophy, it reveals depths and mysteries beyond—and, this is important, quite different from—the ordinary matter-of-fact world we are used to. Science has given back to the universe, one might say, that quality of inexhaustible richness and unexpectedness and wonder which at one time it seemed to have taken away from it. "The world will never starve for want of wonders," says G. K. Chesterton, "but only for want of wonder."

I hope to try to illustrate all this in a moment from the fields of cosmical research which have been my own interest for many years. But just now one general point I want to emphasise is that the scientific approach to things is a far more personal and imaginative activity than is sometimes realised. I am ready to admit that deliberate application to discovery can often take us some distance; also that important progress can result from the operation of a team of workers, as distinct from an individual, though this is mostly the case when the follow-up or consolidation of a basic discovery is in question. But the big jumps ahead are usually the adventures and intuitions of a single mind.

I need hardly remind such an audience as this that scientific activities are twofold. We can make observations and experiments—that is to say, gather facts. And we can also seek to understand how the facts fit together. We express any order we can discern among the welter of facts in the form of a hypothesis or a theory. A theory, by the way, is only a hypothesis that has become, so to speak, respectable. But even then there is nothing final about it. As J. J. Thomson once said, a theory is a policy rather than a creed.

Now, even in this question of making observations, the scientific process is one which requires the fullest and subtlest employment of all our faculties. It demands, for example, that we should not only see things, but should notice them; and not only notice, but perceive them. Many a vital discovery has been nothing else than recognising the unexpected. To encounter nature in this necessary state of awareness is inevitably to find all its forms and movements, from the infinitely small to the infinitely large, full of inexhaustible significance and relevance. But even in experimental work it is the primacy of an imaginative idea or intuition that often starts it all off. In simple words, I might say that the important thing in experimenting is to ask nature the right question and in its most direct form. Only then is the answer clear and

unmistakable. But so often one has failed to ask the right question and the terms of it have to be recast. In this complex process it is as if knowledge were playing a game of chess with the mind, and one has to be constantly on the alert with fresh tactics or even a changed strategy.

Many of our questions turn out to be wrong because they are unanswerable, but it is only by asking them at all that we eventually find we have asked the right one. And one knows how oddly, how unreasonably I might almost say, the right question has often flashed into men's minds. It was recorded by the German physicist Helmholtz that his best ideas only came to him when he was walking up a slowly ascending street —and significantly enough he was one of the founders of the principle of the conservation of energy! What I do know, from my own experience, is the fruitlessness of pondering over a scientific problem too long. The mind gets polarised and thought becomes captive to a groove. How often the best way of solving a scientific difficulty is to leave it alone! Also, speaking as a professional scientist, who has only recently turned amateur, I would like to acknowledge the immeasurable debt which science owes to members of the latter category. My own subject of radio-physics has, on many occasions, been advanced by the observations of the gifted and enthusiastic amateur who was able to recognise the unexpected, even if his professional skill was insufficient to enable him to reveal its full meaning and implication.

Asking nature the right question in the right way—or recognising a theoretical pattern in a tangled skein of experimental data—often has the effect of introducing an element of beauty and elegance into the scientist's work. Do we not, on occasion, refer to a "beautiful theory" and an "elegant experiment"? It is perhaps a little difficult to say what precisely we mean by this. Not, I think, that the theory or the experiment is necessarily conclusive or irrefutable, or even particularly fertile in its consequences—that would be virtue of another kind. The quality I have in mind is that of inevitability—and yet, paradoxically enough, an inevitability which can cause surprise! A great experiment seems to us, somehow, something which could not have been done differently. Or, if it had, something essential would have been lost. We are surprised that someone thought of doing it that way but we can see now that that way is really the only way to do it. Taking away something, or adding something, only detracts from it. In this respect a beautiful experiment can surely be classed with a great work of art.

Now I have spoken in general terms of the scientist's approach to nature and of the kinds of mental quality and awareness that science requires in its followers. And I have tried to suggest that the exercise of these skills has a value in itself which is ample justification of a scientific vocation. To go further might be claiming too much. And yet, I wonder. If we think of the great figures of science and, to be fair, restrict ourselves only to those we have known intimately, can we not go further and say that the scientific vocation, by its very nature, calls for personal qualities that deserve to be recognised and honoured? I might point, for instance, to that tolerance and open-mindedness to new ideas which shine even from the printed page of Rutherford's Address to this Association when he was President here thirty years ago—that freedom from prejudice, muddle, hypocrisy and darkening of counsel which characterised the man many of us were so privileged to know.

And yet, in less serious vein—a vein to which Rutherford was as much addicted as anyone else—ought we not, as scientists, to try to see ourselves as others see us? Joseph Addison once declared that there was this at least to be said for natural philosophy, that it occupied the attentions of men, who, if they had pursued public affairs and politics with equal zeal and vigour, would have set the whole country aflame. While Dr. Hartley in his *Observations on Man* declares that "Nothing can easily exceed the vain-glory, self-conceit, arrogance, emulation, and envy that are to be found in eminent Professors of the Sciences, Mathematics, Natural Philosophy, and even Divinity itself. Temperance in these studies is, therefore, evidently required, both in order to check the rise of such ill passions, and to give room for the cultivation of other essential parts of our natures." And yet Adam Smith, in his *Theory of Moral Sentiments*, finds far more to say in our favour. "Mathematicians and Natural Philosophers," he says, "from their independency upon the public opinion, have little temptation to form themselves into factions and cabals, either for the support of their own reputation, or for the depression of that of their rivals. They are almost always men of the most amiable simplicity of manners, who live in good harmony with one another, are the friends of one another's reputation, enter into no intrigue in order to secure the public applause, but are pleased when their works are approved of, without being either much vexed or very angry when they are neglected. It is not always the same case with poets, or with those who value themselves upon what is called fine writing." I only hope we scientists can see ourselves in that mirror.

For specific examples of what I have called the pursuit of science for its own sake there is, of course, no shortage of material on which to draw. I have, however, decided to tell you the story of only one field of development tonight—a long short story if you like—instead of a number of short stories in brief outline. My story has been selected because it bears on what men think about the world rather than what they do about it, for it concerns the nature of certain objects in outer space whose nature has only been revealed in recent months. If I required a more homely title for my story it would be "Finding things out about places we can't visit."

From time immemorial men have examined the sky with their eyes, and found it to be populated with luminous bodies, the stars shining with their own, and the planets with borrowed, light. As time went on,

telescopes were used to assist the naked eye, and in this way it was possible to see more feeble and more distant stars. Generally we may say that the bigger the telescope the more powerful it is in helping us to plumb further into the depths of space. The 200-inch telescope at Mount Palomar can detect stars so far away that it takes the light from them 1000 million years of travel to reach us. In such cases the human eye is supplemented by the photographic plate which, through prolonged exposure, permits the photography of faint objects which can never be detected by the eye alone. In addition to the telescope the astronomer has also looked at stars with a spectroscope, by which the light from the stars is analysed into its constituent colours. In this way it has been possible to identify the kinds of atoms which exist in stars; since we know, from experiments carried out on the earth, how to recognise particular atoms by the particular colours—or wave-lengths—of the light they give out. We can call all observations of this kind optical astronomy since, in making them, we examine the optical light which comes from the stars.

Now it is of great interest to us here in Liverpool tonight to recall that it was Sir Oliver Lodge, one of the first professors in Liverpool University, who first thought of looking at the heavens with a "radio eye" instead of with an "optical eye." The year was 1900, in the earliest days of radio, and Sir Oliver tried to discover whether he could detect radio waves from our own particular star, the sun itself. The experiment failed because of the insensibility of the wireless receiver used—it was the day of the coherer. Yet it would be no misnomer to call Sir Oliver the first radio-astronomer, for the experiment was surely conceived on right lines and, with modern valve equipment, would have commanded success.

However, it fell to an American radio-engineer, the late K. G. Jansky, of the Bell Telephone Laboratories, to discover that radio waves, as well as light waves, could be received from the heavens. One interesting feature of this discovery was that Jansky found all this out when he was looking for something else. But with impressive scientific awareness he was ready to recognise the unexpected. Jansky was primarily studying the direction of arrival of atmospherics, but he noticed a persisting hiss in his ear-phones when his directional aerial was aligned to receive from a particular direction, which he later showed was the direction of the stars in the Milky Way. The year was 1931.

Jansky, appropriately enough, was the first person to speculate on the origin of this radio noise from outer space. He pointed out that the most obvious explanation was that the radio waves came from the stars themselves and that we get the radio noise in strength from the Milky Way because a great population of stars is concentrated there. But when he came to test his hypothesis by looking for radio waves from our nearest star, the sun, he obtained a discouraging result. For, even with the equipment available in his day, he found, like Sir Oliver Lodge, that no radio waves were detectable.

Now it is one of the remarkable features of the history of this subject that Jansky's researches incited only a few sporadic observations in the way of repetition. During the Second World War, however, radar operators, using their sensitive equipment operating on wave-lengths of 5 to 10 metres, so to speak re-discovered the phenomenon. But that was a period when one had to distinguish sharply between the scientific things that were only interesting as distinct from the things that were really useful. Quite a number of other matters of purely scientific interest arose in the same way, but all one could do was to note them and shelve them till the war was over.

I can well remember how these various topics cropped up, during the War, in the discussions of a panel of young scientific workers of which I had the good fortune to serve as Chairman. This panel was really a small sub-committee, though it had a long name[2] and a distinguished parentage. It used to claim that, unlike most other war-time committees, its membership was confined to scientific workers and did not include officials. That I might have been classed in the latter category was generously overlooked. The task of the Ultra Short Wave Panel was to examine and interpret all the manifold vagaries of radar transmissions which were reported to it from operational experience and from *ad hoc* experiments. The Panel had to concern itself with many things including, for example, the profound influence of the weather on radio wave travel in the lower atmosphere. The foundation of a new subject, that of radio-meteorology, was one result of its labours. That was a matter of practical moment. But the odd bits of information on radio-astronomy, though choice delicacies for a scientific appetite, had to be renounced. I have in mind here, in addition to the detection of radio noise from the Milky Way already mentioned, such subjects as the radar detection of meteors or "shooting stars" and the detection—for the first time—of radio waves of violent intensity coming out of sunspot regions on the face of the sun.

Soon after the War, however, these matters became the objects of further enquiry and it is of much interest to note that radar equipment, developed in the first instance for the detection of aircraft and ships, proved extremely useful for this purpose, requiring only minor adaptations. Dr. J. S. Hey and his colleagues, S. J. Parsons and J. W. Phillips, for instance, made the first really detailed investigation of the amount of radio noise coming from different parts of the sky. For this purpose they converted a war-time radar receiver, which had been used in conjunction with anti-aircraft batteries, into a directional radio-telescope. Their work at once confirmed Jansky's original findings and showed that there was a close agreement between the intensity of the radio emission and the distribution of visible stars in the Milky Way.

Now I must digress from my main theme for a moment to remind you of a little of what is known

[2] The Ultra Short Wave Panel of the R.D.F. Applications Committee of the Advisory Council for Scientific Research and Technical Development of the Ministry of Supply.

about the distribution of stars in the universe as a whole. Our own solar system is really part of the Milky Way which is, itself, a colony or island of stars in space. This island colony has a structure like a magnifying glass, so that it is circular in shape but thicker at the centre than at the edges. You would not be far wrong if you thought of it as a Yorkshire teacake, the currants of which represent the stars. We inhabitants of one of the planets in the solar system do not occupy, however, a particularly privileged position in it, for we are situated nearer to the edge of the island colony than to its centre.

Space is, however, populated with far more stars than are to be found in our own Milky Way. But they are not distributed uniformly. They are grouped in island colonies exactly like our own. The astronomer calls these star colonies extragalactic nebulae, and, with our big modern telescopes, it is possible to detect between 100 and 1000 million of them. The average distance between any one of these star colonies or nebulae and its nearest neighbour is about ten to a hundred times the size of either.

But I must resume my detective story about the radio noise from the Milky Way, for I think you will agree that it sounds much like a detective story as one clue after another is followed up. It was natural to assume at first that the radio noise coming from the sky represented the integrated radio effect of the stars in our own galaxy, since such stars are nearest to us. Our war-time experience concerning radio noise from the sun helped with the necessary calculations, for one could assume, as a first aproximation, that all the stars would act like the sun. However, it turned out that there did not appear to be enough stars in the Milky Way to account for the high intensity of the radio noice. So then, as an alternative hypothesis, it was thought that possibly the noise came from the flying atoms and electrons which we know must populate the space between the stars. This was the inter-stellar matter theory. Unfortunately, here again, there were found to be difficulties. To account for the high intensity of galactic radio noise, when observed on the longer radio wave-lengths, required the ionised gas in inter-stellar space to be at a temperature of 100,000 degrees absolute, a value much too high to be reasonable. Also, we already knew that the inter-stellar material in question is concentrated in a narrow band near the galactic equator quite unlike the wide dispersal of both the stars in the Milky Way and the radio noise. So another theory had to be abandoned.

We had therefore arrived at this position, that the cosmic radio noise could not be accounted for as coming from the visible stars in the Milky Way or from the tenuous material existing in the spaces between the stars. However, this unpromising situation was soon relieved by an experimental discovery which, in its turn, led to others. Dr. J. S. Hey, observing the intensity of radiation from different parts of the sky, noticed that the strength of the radio noise from one particular direction—from a region in the constellation of Cygnus—occasionally showed rapid variations in a period of about a minute. At first it was thought that these fluctuations indicated variations in the emission from the source itself, but we now know that the variations are brought about by irregularities in the ionosphere, through which, of course, the radio waves must pass before they reach us on the surface of the earth. We can, in fact, look upon these variations as a kind of "twinkling" introduced by irregularities in the atmosphere. But the most startling conclusion which could be drawn from these observations was that the source of this variable radio noise must be a very small one. In the case of visual light we all know that we can have a "twinkling" star—because the star is a small source—but not a "twinkling" moon.

Attempts were therefore immediately made to find out, by even more refined radio experiments, how big —or how small—in size this radio source in the direction of Cygnus actually was. There is no time to describe to you tonight the apparatus which was used, in Australia and in Cambridge, to test this matter but I can assure you that both experiments qualify for my adjectives "beautiful" and "elegant." Both sets of investigators announced the same result, that the source in Cygnus was too small to have its size assessed with the equipment used—that is, that it occupied less than a tenth of a degree in the sky. However, in the course of the same experiments, the position of this powerful radio source was fixed pretty accurately. And maps of known stars were eagerly consulted to see if the Cygnus radio star, as we may now call it, coincided with any special visual emitter. The result of this examination was most significant for it was found quite impossible to identify the radio source with any particular star. Within the region which contained the radio star there were many faint visual stars to be found, but none of them seemed to exhibit any special peculiarities likely to associate it with the very powerful intensity of the radio emission.

Then, other parts of the sky were examined with the same apparatus and a further number of "point" sources of radio waves were identified. One was found in the constellation of Cassiopeia, which was even more powerful than that in Cygnus. It also could be located with good accuracy. But, here again, there was no remarkable visible object apparent on the star map to connect it with.

It is important to pause here a moment to consider the effect of these observations on our outlook at the time. It was natural to ask a whole series of questions. Could it be that a radio star is always a dark star—and so a new type of object in the universe? If so, could it be that there was a duplicate universe—only to be seen with a radio-telescope as distinct from a visual telescope? And, as regards the overall phenomenon itself, could it be that the total emission of radio waves from the galaxy might be really the integrated effect of these dark stars, just as the diffuse band of light of the Milky Way arises from the unresolved radiation from distant optical stars? You will see that the tendency of the time was still to think of the radio emitters as being neighbouring bodies and

inhabitants of our own galaxy rather than of other, more distant, island colonies or nebulae. However, a little reflection will show that we must not rule out the possibility of radio nebulae, as distinct from individual radio stars, even if we suppose that the greater part of our own radio noise comes from our own galaxy, the Milky Way. Any observer well outside the Milky Way should be able to detect the radio emission just as we, who are situated inside it, can do. Such an argument received strong experimental support when a group of radio astronomers in Manchester noted a relatively faint, but quite detectable emission, from the Andromeda nebula, which is a neighbouring stellar island colony of our own. Further work, at Manchester and Cambridge, has revealed appreciable radio emission from other nebulae not far from our own galaxy. It is clear that, in such cases, we are probably detecting their internally generated radio noise from the outside.

But the problem of the much more powerful sources remained. Where were they, why were they so powerful, and were they, basically, radio stars or radio nebulae? Again it was a case for more refined experiments which would enable their positions to be found with greater precision and give some notion of their sizes. I might mention here, in passing, that workers in Sydney, Australia, under the lead of J. G. Bolton, had already tentatively identified one radio star with the Crab nebula, a diffuse, expanding, cloud of gas which represents the remains of a stellar explosion, visible news of which reached the earth, according to Chinese records, on July 4, 1054 A.D. So this was another radio source identifiable with a visible object, but it was of abnormal type, the ancient relic of a supernova eruption.

The real attack on the identification of the two major radio sources, those in Cassiopeia and Cygnus, depended on the more accurate identification of their positions. In 1951 some new determinations were made by F. G. Smith at Cambridge and the results were communicated to the optical astronomers with an invitation to search afresh the parts of the sky in question. In the spring of 1952, a new and intensive optical search was therefore undertaken by Baade and Minkowski, at Mount Palomar, using the 200-inch Hale telescope and the 48-inch Schmidt telescope. As a result of this meticulous search, two entirely unknown objects were discovered in the universe. The Cassiopeia radio source was found to be associated with a diffuse cloud of luminous gas, situated within our own galaxy, and possessed of unique characteristics. The tenuous matter of which it is composed is concentrated in a number of fine filaments which are in the most violent motion. From a study of the colour of the light emitted by different parts of the same filament it is concluded that the velocities of such movement are of the order of several thousand kilometres per second. The origin of this gaseous cloud is unknown for it seems impossible to regard it as yet another supernova explosion.

The source in Cygnus, which you will remember was the one which first gave the clue to the possibility of radio stars, was found to be an entirely different type of object. Here the source of the radio waves was identified with another exceptional object which is considered to be two island colonies—two extra-galactic nebulae—in collision. Moreover, the distance away of this compound group of stars is estimated as being such that it requires 100 million years for the light and the radio waves generated in it to travel to us here on the earth. It is rather a humbling thought that it is only during the last sixty years of that travel that human beings have managed to learn how to produce radio waves and receive them. Now when a collision of two nebulae takes place it is considered that the stars of one island colony will pass freely between those of the other. On the other hand, the more extensive inter-stellar materials of the two island colonies will meet in collision, which will result in high excitation of the gaseous atoms of which this material is composed. One must suppose that, in both the radio source in Cassiopeia and the colliding nebulae in Cygnus, the high gaseous velocities give rise to this intense radio emission, although the detailed mechanism by which it all comes about is not understood. These identifications were finally confirmed by observations in Manchester, Sydney and Cambridge using still more refined methods of finding the sizes of these radio sources. The results of all three radio-observatories were gratifyingly consistent and were published simultaneously last December. In all cases it was found that the radio sources examined were definitely much bigger than simple stars and therefore corresponded to the sizes of the objects observed optically.

The accurate location of these radio sources in the universe—we must now, I think, drop the term "radio stars"—has therefore led to new discoveries of great astronomical interest. Two unknown objects of unique character have been identified in the heavens, as a result of clues from the radio side; and it is to be expected that future accurate measurements of the positions of these cosmic radio emitters will lead, in turn, to the discovery of other visual objects of uncommon types. I should explain that the discovery of these rare objects by direct visual search with large optical telescopes would require quite prohibitive effort. The radio-telescope has therefore shown itself to be an important adjunct to the world's greatest optical telescope. But, in addition, there is a further and far-reaching possibility. It is the astronomer's ideal to reach, with optical ranging, the hypothetical limit of the expanding universe, the distance where the extra-galactic nebulae are receding from us with the velocity of light. So far he has reached very approximately half-way. But the fact that, already, the second most intense radio source can be detected without difficulty at a distance equal to one-tenth of the maximum distance plumbed by the 200-inch telescope suggests that it may, in time, be possible to detect sources at greater distances by radio than by optical means.

But, in any case, the more detailed radio mapping of the radio sources in the heavens must go on; for, as

you will have gathered, we are still without an explicit solution of the original problem which started it all off, namely the rough overall correlation of the distribution of radio noise with the general structure of the Milky Way. Much progress in these matters can, I am sure, be expected from the operation of two large British radio-telescopes. Professor A. C. B. Lovell's group is constructing a large steerable paraboloid of 250 feet diameter at Jodrell Bank, a station of the University of Manchester, which will be the largest single radio-telescope in the world and available for a great variety of investigations; while the large interferometric radio-telescope, recently completed at Cambridge, for work by M. Ryle and his associates, is already yielding entirely new results in the detailed mapping of radio sources.

The radio-astronomical story is therefore far from being fully told, but even already one can record achievements in these three centres of Cambridge, Sydney and Manchester—partly in competition and partly in collaboration—worthy to be ranked with the greatest feats in the art of experiment.

I have only a few words to add by way of postscript. I have tried to show how science, pursued for its own sake, can enlarge men's horizons and invest the world with deeper significance. As an exercise we can claim it to be one of the most complex and far-ranging of our mental experiences. But we must not forget that there are other values and other experiences. At the opposite pole from our scientific endeavour there are the ways of thought which do not change, whose concern is with what is *not* new, with the things that will not be superseded; and today we stand in need of these enduring and sustaining values of the spirit more than ever. We well know that, in the field of science, our work will in due course be probably outdated and certainly surpassed. At any one moment we may have only a precarious hold on a temporary truth and our consciousness of this ever urges us to seek fresh truths and new understandings. I fear that, in doing so, we may lose sight of other aspects of life which have their values too. For, you know, there is a virtue in contentment, in being satisfied with what we already have, which we shall not learn from science. Our vocation, in other words, cannot be the whole of life for it cannot satisfy all our needs. Nevertheless, I hope I have represented it fairly as no unimportant or unworthy part of it. For we scientists are specially fortunate in this, that our vocation can never be simply an occupation; it is, by its very nature, more than that—a dedication to an end. It often seems to me that what we lack in the world today is not so much the impulse to dedication as the opportunity for it. This, at least, the scientist need never lack; the opportunity is open to him everywhere "to strive, to seek, to find and not to yield." To those words of Tennyson's Ulysses I would add the words which Dante, long before, put into the mouth of the same Ulysses, when he encourages his crew to venture with him, beyond the furthest point of the known world:

> "O, brothers," he said, "who through a hundred thousand dangers have reached the West, deny not, to this brief vigil of your senses that remains, experience of the unpeopled world behind the sun. Consider your origin: you were not formed to live like brutes, but to follow virtue and knowledge."

To Ulysses and to Dante "experience of the unpeopled world behind the sun" meant, of course, the adventure of voyaging out into the Atlantic, where the sun set and the world came to an end. Tonight, as I have tried to show, the scientist has commissioned the words to take on a different—and, indeed, a quite literal—meaning.

But we must still ask ourselves what it is that urges men to do these things and our answer must surely be that it is the challenge of it all. Why should anyone want to climb Mount Everest? Simply, I suggest, because it is there—as a challenge of the unknown and the unaccomplished—a challenge to spirit and body, now so gloriously met by Hillary and Tensing. In its different setting, the pursuit of science also presents to the human mind an enduring challenge on an endless frontier, quite apart from the material enrichment of mankind to which it may incidentally give rise. "The work may be hard, the discipline severe," as Lord Rayleigh said on an occasion similar to this, nearly seventy years ago, "but the interest never fails and great is the privilege of achievement."

A Plea for More Fundamental Research Effort[1]

William D. Coolidge

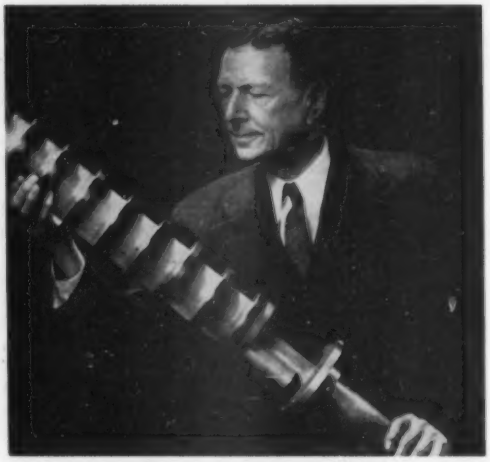
Research Laboratory, General Electric Company, Schenectady, New York

DURING OUR PRODUCTIVE YEARS, we all take ourselves pretty seriously, and if we did not, it would be bad for our work. When we retire, however, and get out of harness, we see ourselves and our achievements in truer perspective. We see how much of our success was due to our associates, and how much of it was due even to chance. To illustrate this last, I was given the privilege, and a very free hand, to work on tungsten at exactly the right time. In the same way, I had the privilege, at exactly the right time, of applying to the x-ray tube Dr. Langmuir's new knowledge of thermionic emission. I cannot take any credit for having been at the right place at just the right time, and had it not been for Dr. Whitney and E. W. Rice, I would not have been there at all.

There is another thing that makes one feel very humble, and that is seeing the accomplishments of people living in earlier civilizations and working with what we would consider entirely inadequate means. In Mexico and Central America, for example, you are astounded by the ruins of the Ancient Mayan civilization. Although living in their stone age, with no metal tools, no beasts of burden, and without the invention of the wheel, they still built large and beautiful and most impressive structures of stone—temple pyramids, palaces, and stone-paved roads. Without optical instruments, with nothing but lines of sight, as through holes in stone walls, they determined the number of days that it takes the earth to travel around the sun, with such precision that their value differs by only 0.0002 of a day from our latest value. In Egypt this past winter, we saw things made long before the Christian Era, involving such beautiful design and such exquisite workmanship that one was inclined to question whether these things could be duplicated today.

I suppose I am expected to indulge in reminiscence, or to tell what I can see for the future in the crystal ball. But age may have brought discretion—I shall do neither.

Cleveland has been the meeting place of scientists engaged in metallurgical research. They will, I am sure, have made intelligent predictions of things to come in their field. They will certainly have told you of recent strides made in getting a better understanding of the solid state, in general, and of the crystalline state in metals, in particular. You can safely predict that such new fundamental knowledge will lead to metals with more desirable physical properties than are attainable today. Cleveland has also been the meeting place of scientists and engineers actively interested in the nondestructive testing of the integrity of metals and other materials. The high standard of living which we, in this country, enjoy today is due in no small measure to the high quality of our metals and other structural materials, and to nondestructive tests used to maintain that quality.



Dr. W. D. Coolidge, director emeritus, General Electric Research Laboratory, studies the multisection 2,000,000-volt x-ray tube, one of the major developments with which he has been associated during his long and fruitful career.

There is one prediction which I will make. If, in the future, our present high standard of living is to be maintained in the face of foreign competition, we will find that the job is harder than it has been. The world has rapidly grown smaller, and this makes it easier for others to learn about and to adopt anything that is good in our methods. It is clear that the other fellow is learning very fast. It seems but a few years ago that we had a visit from an official of the International Harvester Company, who told us a little about their experience with the Russians. The Harvester Company had been selling its machines to the Russians, who were then starting to build their own. The Harvester man was quite unimpressed by this, however, for, he said, "The Russians have no mechanical sense." In support

[1] Based on Dr. Coolidge's talk at the dinner honoring his eightieth birthday at Nela Park Lighting Institute, Cleveland, October 20, 1953.

of this statement, he said that crates of ball-bearings sent to Russia had been allowed to stand out in the rain there until ruined. When I visited a few laboratories and factories in Moscow and Leningrad in 1933, I found the Russians very much alive to their technical backwardness, and doing something about it. As an illustration, their arrangement with Mr. Ford had brought them Ford and Lincoln cars and Ford engineers to teach them how to build cars. We had lent them our Mr. Lenox from Pittsfield, who had been with them for three years teaching them how to build transformers. In an incandescent lamp factory, I saw them making tungsten lamps with American lamp-making machinery. Since then, they must have got great help from the German engineers they acquired after the war. I cite this Russian case only as an illustration of the fact that, in this small world, a backward nation can, under pressure, make very rapid headway.

In Japan, in 1947, I had, for forty days, the privilege of visiting laboratories and factories. Two things that impressed me very strongly were these: in the first place, for several reasons, science had entered very little into Japanese industry, and, in the second place, inspection at various stages of manufacture seemed to have been quite inadequate. But these deficiencies could, of course, be corrected, and today I find some recent Japanese accomplishments in the optical field very impressive. In this field we see them selling binoculars, microscopes, and telescopes in this country, in competition with those of U.S. manufacture. We also see them selling cameras with very superior high-speed lenses.

When the foreign-made product becomes as attractive as that made here, and when equipment and methods become such that the productivity of the worker in a foreign country is as great as that here, and this while he has a very low standard of living, his competition will be more to be reckoned with than we have had in the past. I think that if our present standard of living is to be maintained and, as we hope, improved, the only real answer to such competition is continuous effort on our part to improve old devices and develop radically new ones.

The thought of radically new devices should take us back to the time, prior to 1900, when E. W. Rice, supported sympathetically by Professor Elihu Thomson, A. G. Davis, and Dr. Steinmetz, decided, as an experiment, to establish a General Electric research laboratory. The impelling motive was the thought that the firm's manufactured products were, at the time, practically all based on the fundamental researches of Michael Faraday and Joseph Henry. The hope was that a General Electric basic research laboratory could establish further new scientific facts and principles that could serve as a basis for new devices. This hope has, I am sure, been realized, and our management continues sympathetically and enthusiastically to support basic research.

One of the best examples that I can give, showing how fundamental research can be made to pay, is that of Dr. Langmuir's work in the two fields of thermionic emission and gaseous heat conduction. From one, we have our whole family of high-vacuum tubes, and from the other, the gas-filled incandescent lamp.

The idea of applied research seems to have been adequately sold, but, speaking for the country as a whole, far too little effort is going into basic research. Most of our colleges are pinched for money and will today certainly find it easier to sell the services of their staffs for work in applied science, directed to some specific end, rather than for work in basic research, which may or may not lead to useful applications. Not only this, but even the field in which its applications might lead is unpredictable.

Everybody can see tangible results, but they can easily forget the basic research that established the new facts or principles and made these results possible. It is most desirable that our educational institutions, our scientific societies, our industrial organizations, our labor organizations, and our government encourage and support basic scientific research. With sufficient basic and applied research, we can confidently hope to maintain and even raise our present high standard of living.

Looking still further into the future, may not a continuous supply of new frontiers, provided by basic research, prevent the stagnation that might otherwise develop in our Western civilization? It is very impressive, and almost frightening, to see some of the remaining evidence of the wonderful achievements of the Mayan civilization in Central America and the Egyptian in Africa, and then to read of the rise and fall of other civilizations, and finally to note the shortness of time involved in each case. It is clear that there have been various causes contributing to the decline of different civilizations. It seems equally clear that a constant supply of new horizons would not of itself guarantee the continued existence of a civilization. It might well prolong it, however, and would certainly add zest to living.

In closing, let me recommend to each of you, on the chance that you may sometime retire, that you then see for yourself something of older civilizations, starting perhaps with the Mayan. Go to Yucatan and spend at least four days seeing Chichen Itza and Uxmal. They will be four of the most thrilling days of your life. One of the greatest advantages of travel, after retirement, when your mind is free of business cares, is the rosy light it throws on your home—on the place where your friends are.

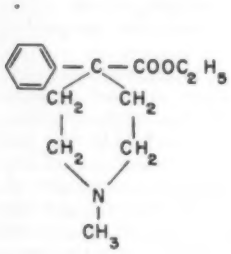
Steric Considerations on the Chemical Structure and Physiological Activity of Methadone and Related Compounds

Alexander Gero

Department of Pharmacology, Hahnemann Medical College, Philadelphia, Pennsylvania

THE DISCOVERY, in 1939, of the morphine-like physiological action (*1*) of meperidine (γ-phenyl-γ-carbethoxy-*N*-methylpiperidine) (I) focused attention on the *N*-methylpiperidine grouping as the essential fragment of the morphine molecule (II), rather than the phenanthrene or dibenzofurane groupings which had been favored earlier. In fact, with one exception, all morphine substitutes in clinical use today are derivatives of γ-phenyl-*N*-methylpiperidine. The exception is methadone

I



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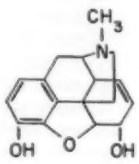

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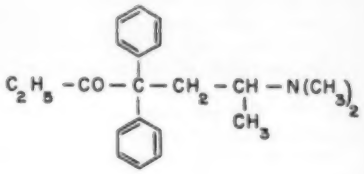

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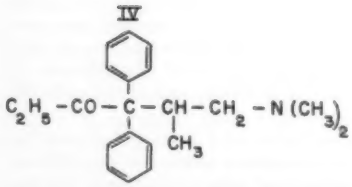

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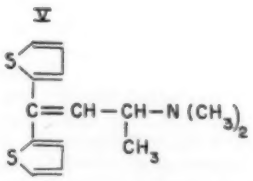
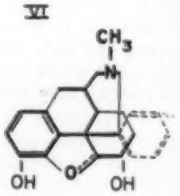


VI



(III), which like the other morphine-type analgesics, contains a benzene ring attached to a tertiary nitrogen but, unlike the others, is an open-chain amine rather than a piperidine derivative. This difference in structure has made it impossible to correlate the analgesic activity of these compounds with any definite structural feature.

Besides methadone itself, many of its analogues and derivatives have been studied, some of which show appreciable analgesic action. Thus isomethadone (IV) is only somewhat less active than methadone (*2*) while the activity is lost when the carbon chain between the quaternary carbon and the nitrogen is lengthened or shortened (*3*) or when one benzene ring is moved to the neighboring carbon atom (*4*) or is replaced by other groups such as benzyl or allyl (*5*). On the other hand, replacement of the carbonyl group of methadone by a sulfo group yields a highly active compound (*6*). Reduction of the carbonyl group to carbinol diminishes the activity but acetylation restores it (*7, 8*). Perhaps the most remarkable observation is that the remotely related compound (V) is highly active; saturation of its double bond reduces but does not abolish its activity (*9*).

There has been some controversy on the question whether methadone and its derivatives should not be classed by themselves rather than be forced into relationship with other morphine-type analgesics. Bergel and Morrison (*10*) state that a model of the methadone molecule shows spatial compactness and similarity to morphinan and the phenylpiperidines, but Eddy (*11*) and Bockmühl and Ehrhart (*5*) fail to see any such similarity. Nor do Adamson and Green (*9*) see any possible structural relationship between their

dithienylbutenyldimethylamine (V) and morphine.

It was hoped that an accurate scale model of the methadone molecule might reveal factors not readily seen in a conventional structural formula, and that it would throw more light on the possible relationship of methadone to morphine than the somewhat cryptic statement of Bergel and Morrison (*10*) about the "compactness" of the methadone molecule. Such a model was constructed from aluminum spheres, precision-ground to the known atomic diameters on the scale 17¼ mm : 1 A and connected by pegs and holes at the correct bond angles.[1]

The model showed that the bulky phenyl, methyl, and propionyl groups impose considerable steric restraints on the methadone molecule, not in the sense of any impossibility of rotation but rather in that parts of the molecule can rotate only if they do so in concert with other parts of it. Such concerted rotation is obviously contrary to randomness and thus represents a decrease in entropy. This does not happen of itself in a physical system, hence such steric impediment is equivalent to a degree of steric hindrance and restrains the methadone molecule to some apparent rigidity.

Another observation was that the protons of one N-methyl group can actually touch the oxygen of the carbonyl group. This writer has shown that under such circumstances a C—H—O hydrogen bond arises (*12*) which in the present case further confines the methadone molecule to a pseudo-rigid position. This position is shown in Fig. 1, a photograph of the methadone model. It is clearly seen that the steric factors mentioned above force the six atoms, which are marked with a cross in the photograph, into a position closely resembling a piperidine ring. These atoms are C_1 of one of the benzene rings, the quaternary carbon, and the —C—C—N—C— chain of the 2-(dimethylamino-)propane group. The model shows that the gap in the ring is about 2.1 A wide which is only 38% more than the length of a C—C single bond.

Similar model studies on the related compounds listed above seem to show that the same factors operate in all of them to determine whether a compound is analgetically active. When the carbonyl group of methadone is replaced by a sulfo group, the semi-ionic S→O bonds make the oxygen atoms more strongly negative than in C=O so that the N-methyl group is held in position even more rigidly than in methadone itself. Hence the analgesic activity of the sulfone analogue of methadone (*6*). The model of isomethadone also shows the same possibility for the formation of a six-membered pseudo-ring as the methadone model, but obviously no such ring is possible when the chain between the nitrogen and the quaternary carbon is longer or shorter than in methadone. Furthermore, the models reveal far less steric impediment when one or both benzene rings are replaced by benzyl or allyl groups, or when one of the benzene rings is shifted to the adjacent carbon atom. Thus the molecules of these compounds must be more flexible and less prone to force their atoms into the semblance of a piperidine ring.

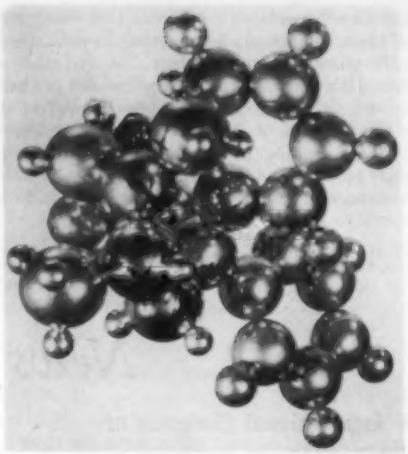
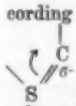


FIG. 1. Photograph of the methadone model.

In methadol, the carbinol corresponding to methadone, the oxygen is more weakly negative than the ketonic oxygen of methadone, hence less able to hold the basic chain in position through a C—H—O hydrogen bond. A more important effect here must be a hydrogen bond between the OH and the nitrogen, which is sterically perfectly possible; but then the gap in the ring is greater than in methadone. The reverse is true of the compound obtained by acetylating the carbinol: the removal of the proton from the oxygen also removes the possibility of an O—H—N hydrogen bond while the newly introduced carbonyl group in the ester restores a C—H—O bond, this time in such a position as to close the gap in the ring almost completely.

As to (V), while it lacks the bulk of the propionyl group and the steric impediment provided by the O—H—C bond, the rigidity of its double bond contributes to the rigidity of the basic chain. If electronic effects are also taken into account, it must be assumed that the two sulfur atoms, positively charged by resonance, will tend to be as far as possible from each other while the $\overset{\delta+}{CH_3}—\overset{\delta-}{N}$ group will align itself according to electrostatic attraction alongside the



part of a thiophene ring. The result is, again, a semi-rigid structure imitating a piperidine ring. Saturation of the double bond somewhat diminishes both the rigidity of the structure and the analgesic effect of the compound.

Thus we can now correlate the structure of methadone and its derivatives with that of morphine, meperidine, and other related analgesics and state that the

[1] The author wishes to express his thanks to E. H. Cox of Swarthmore College for the loan of his molecular models.

common and (probably) essential structural feature of all these compounds is an actual or virtual γ-aryl-(mostly phenyl-)-N-methylpiperidine system.

The relationship between morphine and methadone, postulated in the foregoing, is brought out in structure (VI), a composite structure of morphine and methadone, showing in thin lines structural features peculiar to morphine, in broken lines those peculiar to methadone, and in heavy lines those common to both.

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News and Notes

XIV International Congress of Zoology, 1953

The second post-war International Congress of Zoology was held in Copenhagen, Denmark, Aug. 5–12. Forty-six countries were represented, with a delegate from the United Nations in addition, with a total of 562 delegates and members. The largest delegation was that of Denmark (104), followed by Germany with 70, the United States 59, the United Kingdom (without the Dominions) 57, Sweden 30, Italy 24, Netherlands 19, Norway 13, Finland 4, and others. The Russian delegation of 6 members took an active part in the meetings, speaking in other languages as well as in Russian, and in general exhibiting a much greater degree of freedom and of willingness to cooperate in scientific matters with the western nations than had been the case in Paris in 1948. A gift of some 150 bound volumes of recent Russian zoological publications was made to the University of Copenhagen.

Fifteen papers were presented by the members at general meetings, and about 265 to the sixteen sectional meetings. These were arranged for Nomenclature (7); Paleozoology (6); Zoogeography (10); Evolution and Genetics of Populations (12); Cytology (13); Morphogenesis (41); Animal Psychology (8); Comparative Physiology (43); Serology and Paper Chromatography (6); Parasitology (11); Nematology (10); Terrestrial Ecology (14); Hydrobiology (25); Terrestrial Arthropods (21); Invertebrates (11); and Vertebrates (17); the figures in parenthesis are the number of papers offered for each section. There were in addition two major Colloquia, one, with 13 invited papers, on the Deep Sea Bottom Fauna, and one on the problems of zoological nomenclature.

The Colloquium on Zoological Nomenclature was called by the International Trust for Zoological Nomenclature to meet July 29–Aug. 4, in advance of the Congress proper. Nearly fifty representatives of societies and institutions interested in these problems convened, and their long and arduous meetings continued throughout the week scheduled, often until midnight. The proceedings of the Colloquium made it possible to present 142 specific recommendations to the Section for Nomenclature of the Congress, all of which had been exhaustively discussed by the members of the Congress attending the Colloquium. With this previous discussion, it was possible to take action on the numbered proposals, with active discussion only of certain controversial items. Among these was the modification of the so-called Law of Priority in the interest of nomenclatural stability. Strong support for such modification came from the zoologists in general, and was opposed mainly by those who seek to divorce zoological nomenclature, as an independent activity, from zoology. (See "Zoological Nomenclature: Decisions taken by the Fourteenth International Congress of Zoology," by Francis Hemming, in this issue, p. 131.)

The results of the action of the Colloquium and of the Section for Nomenclature were ratified by the Congress as a whole and accepted by the International Commission on Zoological Nomenclature which met concurrently. Certain actions of the previous Congress in Paris (1948) were reversed, and various problems, postponed by the Paris congress for further study and for action in 1953, were dealt with. Comprehensive revision and rewriting of the rules, as of 1953, was thus made necessary, and this was placed in the hands of J. Chester Bradley, Cornell University, President of the Commission. The resignation of Francis Hemming, secretary to the Commission, was accepted, to take effect in 1955, with division of the duties of that office by the establishment of a separate post for the editor of the *Bulletin for Zoological Nomenclature*. Mr. Hemming received a special vote of thanks for his efforts throughout his tenure of office and especially for his conduct of the Colloquium preceding the Congress.

The meetings of the scientific sessions and especially the discussions following individual papers were extremely stimulating, and of course scarcely less so were the continuing informal discussions that went on in the corridors of the lecture halls, over luncheon

and tea tables, and elsewhere into the night. The European emphasis on Morphogenesis and Comparative physiology is reflected in the preponderance of papers in those sections.

Reports of the results of investigations of the Danish oceanographic expedition on the *Galathea* may be named as the highlight of the meetings, with a public illustrated lecture by Anton Fr. Bruun, leader of the expedition, and exhibition of specimens from the greatest depths (the Philippine trench) thus far reached with collecting apparatus. These results were in turn the principal interest of the Colloquium on the Deep Sea Bottom Fauna.

The arrangements made by the organizing committee, headed by R. Spärck, with Anton Fr. Bruun as Secretary General and H. Volsøe as Treasurer, were extremely satisfactory. The several excursions arranged for the members to North and South Zealand and to the Island of Bornholm in the Baltic were well attended and proved to be of great zoological and geographic interest. The Congress accepted the invitation of Great Britain to hold the next Congress, scheduled for 1958, in London.

KARL P. SCHMIDT

Chicago Natural History Museum
Chicago, Illinois

Dinner for William D. Coolidge

William D. Coolidge, of Schenectady, N.Y., former vice president and director of research for the General Electric Company, was honored on his 80th birthday in Cleveland, Oct. 19, by more than 100 friends and associates. Dr. Coolidge is noted chiefly for his discovery in 1908 of a means for making a tough metal, tungsten, into an extremely pliable one which could be drawn into wire one-sixteenth the diameter of a human hair. That discovery made practical the use of tungsten as filaments in lamp bulbs, and is chiefly responsible for their long life and high efficiency. Later Dr. Coolidge extended this new knowledge by developing an x-ray tube of a type in virtually universal use today.

Four large units of General Electric, which owe their present status to Dr. Coolidge's inventions, united to honor the scientist with a reception and dinner at Nela Park in the Lighting Institute. They are the Lamp Division, Electronics Division, X-Ray Department, and Carboloy Department. Tributes to Dr. Coolidge were given by leaders of the business and scientific world. Clyde Williams, director of the Batelle Memorial Institute of Columbus, Ohio, was the chief speaker. C. Guy Suits, G-E vice president and director of research, also addressed the meeting. William H. Robinson, Jr., manager of public relations for the G-E Lamp Division, was toastmaster.

On Oct. 20 Dr. Coolidge participated in the program of the 13th annual convention of the Society for Nondestructive Testing, Inc., by presenting on behalf of the Society and the G-E X-Ray Department, the first annual William D. Coolidge Award to the author of the year's outstanding paper on x-ray. Winner of the award is D. T. O'Connor, chief of the Radiology Section, U.S. Naval Ordnance Laboratory, White Oak, Md.

As early as 1941, W. D. Coolidge was associated with the Atomic Bomb project. He was appointed to a committee of 6 to evaluate the military importance of uranium and to recommend the amount of funds which should be devoted to exploring the question. When the atomic bomb was tested at Bikini in 1946, Dr. Coolidge was on hand as a special observer for the Manhattan District. Later the same year he helped organize the laboratory at the Hanford Works, the plutonium-producing plant near Richland, Wash., which G-E operates for the Atomic Energy Commission

Even a brief summary of Dr. Coolidge's researches and inventions—which have benefited all mankind—reads like the achievements of a whole laboratory rather than those of a single man. His x-ray equipment alone has saved many lives and prevented untold suffering. The efficient, low-cost, artificial lighting which he helped to produce has increased productivity in our factories, safety on our streets and highways, and comfort and beauty in our homes. His tungsten developments practically eliminated the ignition troubles once prevalent in our automobiles, and in two great wars he gave substantial help to our armed forces. His inventions include the first electronic submarine detector.

Science News

In the Dec. 26 issue of the British journal *Nature*, F. Friedberg, L. M. Marshall, and L. H. Newman of Howard University Medical School have reported the discovery of an unknown **acid in the brain.** The acid contains 54.3% carbon and 10.4% hydrogen. It was found by the partition chromatography method of separating chemicals in a mixture. Silica gel was used as the medium for the separation.

The **chemical synthesis of sugar,** attempted futilely for years, was reported at the 124th national meeting of the American Chemical Society by Raymond U. Lemieux, a Canadian, and George Huber, a Swiss; both are on the staff of the National Research Council of Canada. This accomplishment promises to make the synthesis of many complicated substances a matter of easy routine; it also permits biochemists to prepare sugar containing radioactive atoms that can be traced through life processes.

Under the electron microscope, **details of the chloroplast,** site of the process of photosynthesis, have been photographed for the first time by two scientists at the University of California at Los Angeles, Morris Cohen of the botany department and Edwin Bowler of the engineering department. A side view of the tobacco leaf chloroplast in a section about 0.000002 in. thick reveals two kinds of stratification. Stacks of finely lamellate grana lie embedded in a general system of thicker lamellae which traverse the chloro-

plast; chlorophyll is localized in the grana. The layering of the chlorophyll in the fine lamellae of the stacked grana may be involved in the absorption of light.

A new carbon-dating process developed by four University of Manitoba scientists makes possible the dating of any carbon-bearing matter—human bones, fossils, and vegetation—from as far back as 40,000 years and, for average samples, within 10 years of actual age. It was not until 1950 that any accurate technique for the dating of archaeological remains was developed; then W. F. Libby and his colleagues at the University of Chicago perfected a carbon-dating method that estimates ages of specimens up to 25,000 years by measuring the activity of carbon-bearing samples in a screen-wall type of Geiger counter. The new process utilizes a liquid scintillator, with the material to be dated incorporated in the liquid.

The 1953 Trans-Pacific Expedition, fifth postwar expedition of the University of California's Scripps Institution of Oceanography, returned to San Diego recently aboard R/V *Spencer F. Baird*. Under the leadership of Warren S. Wooster, scientists of the Scripps Institution spent four and a half months in oceanographic exploration of the North Pacific Ocean. The expedition was sponsored by the Office of Naval Research and the Bureau of Ships of the United States Navy. Findings will be published in appropriate Japanese and American journals.

The major scientific program was a study of the relationship between the major circulation features, the distribution of physical and chemical properties, and the distribution of plankton and nekton. One hundred thirty-five stations were occupied in sections across the prominent permanent currents of the North Pacific and the deep Bering Sea (Fig. 1). In addition to measurements of temperature, salinity, dissolved oxygen, phosphate total phosphorus, silicate, and iron to depths as great as 6000 meters, collections at various depths were made of fish, zooplankton, phytoplankton, and bacteria. The deepest biological collections were made with the midwater trawl and the diving dredge, bringing up organisms from as deep as 5100 meters.

Between stations a continuous echo-sounding record was kept. Several new sea mounts were discovered, and numerous crossings of the Aleutian and Japan Trenches were made. The geological program also included bottom sampling by coring and dredging, and the collection of volcanic material from Bogoslof and Bayonnaise Rocks.

One important outcome of the expedition was the opportunity for Japanese and American oceanographers to exchange ideas. The first American oceanographic vessel to reach Japan since the *Carnegie's* visit in 1929, the *Baird* had thousands of Japanese come aboard during her stay in Hakodate, Tokyo, and Kobe. Members of the scientific party also had an opportunity to discuss their work with Emperor Hirohito as well as with leading Japanese scientists. The following seven Japanese scientists participated in the work in Japanese waters: Chikayoshi Matsudaira, Tohoku University; Sigeru Motoda, Hokkaido University; Albert Y. Takenouti, Hakodate Marine Ob-

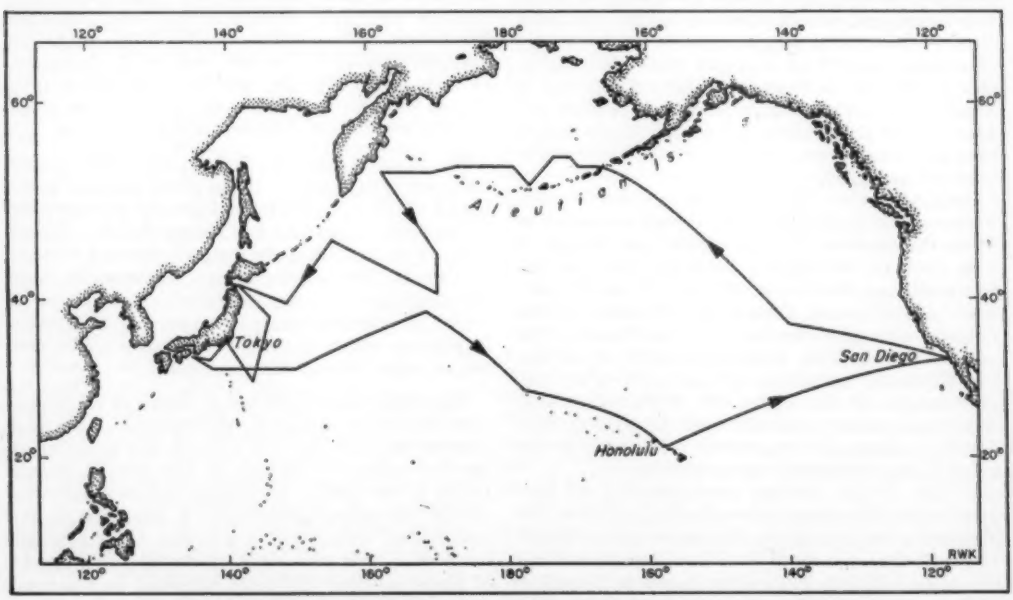

FIG. 1. Trans-Pacific Expedition track. [Courtesy of Warren S. Wooster.]

servatory; Michitaka Uda, Tokyo University of Fisheries; Hiroshi Niino, Tokyo University of Fisheries; Takao Sakamoto, Tokyo University; and Daitaro Shoji, Japanese Hydrographic Office.

The *Harvard Alumni Bulletin* of Nov. 28 presents a well-balanced article on **Wendell H. Furry,** associate professor of physics at Harvard University, entitled "The Furry Case: A Summary of the Facts and an Analysis of Their Significance as They Appear to a Harvard Lawyer," by Livingston Hall, vice-dean and professor of law at the Harvard Law School.

Scientists in the News

Roger Adams, head of the University of Illinois Chemistry Department for 28 years, has asked to be relieved next fall of administrative duties. He will continue as a research professor. Prof. Adams has been associated with the university since 1916.

President Eisenhower recently named **Allen V. Astin,** director of the Bureau of Standards, as chairman of the government's Interdepartmental Committee on Scientific Research and Development. Dr. Astin has been a member of the committee for several years. The chairmanship is rotated annually.

The American Institute of Chemical Engineers has presented its 1953 Junior Member Award to **Leroy Alton Bromley,** associate professor of chemical engineering at the University of California, Berkeley. The award is granted for outstanding papers published in *Chemical Engineering Progress* for the preceding three-year period by a junior member. Dr. Bromley received recognition for his articles "Heat Transfer in Stable Film Boiling" and "Pressure Drops for High Vacuum Flow of Air Through Annular Sections" (with C. R. Alancraig).

The Sedgwick Memorial Medal for distinguished service in public health, highest honor of the American Public Health Association, has been presented to **Carl E. Buck** of the University of Michigan School of Public Health.

In April **Charles L. Buxton** of the College of Physicians and Surgeons, Columbia University, will join the faculty of the Yale University School of Medicine as professor of obstetrics and chairman of the department. He succeeds Herbert Thoms, who retired last June after 31 years of service.

Kenneth N. Campbell, for many years a professor of chemistry at the University of Notre Dame, has resigned to accept the position of director of medicinal chemistry at the Mead Johnson Research Laboratories, Evansville, Ind. His wife, **Barbara K. Campbell,** has also resigned from her post as lecturer in chemistry at Indiana University in order to become a special consultant for Mead Johnson.

Benjamin Castleman has been appointed clinical professor of pathology at the Harvard Medical School and chief of the Department of Pathology at the Massachusetts General Hospital. An authority on pathological conditions associated with hypertension and disorders of the parathyroid and thymus glands, Dr. Castleman has been working at the Massachusetts General Hospital since 1931, and in 1935 became a member of the Harvard teaching staff. He has been acting chief of the Hospital's Department of Pathology since 1951.

Ernest Carroll Faust, professor of parasitology in the Tulane University School of Medicine, was recently honored by exercises in observance of his 25 years of service. A portrait of Dr. Faust, sponsored by his associates and students, was presented to the school following a eulogy by Henry F. Meleney, research professor of medicine at Louisiana State University.

Lester M. Field has resigned from Stanford University to accept appointment as professor of electrical engineering at the California Institute of Technology, where he has been a visiting professor since Jan. 1, 1953.

The Association of Geology Teachers recently named **Fritiof Fryxell,** professor of geology at Augustana College, Rock Island, Ill., as the first winner of the Neil Miner award. This was established last year to recognize meritorious accomplishment in stimulating interest in the earth sciences. Prof. Fryxell has been teaching at the college since 1923, and during most of this time has maintained a "one-man department." A tribute to Prof. Fryxell's effectiveness as a teacher is the fact that during his tenure over 100 students have graduated from Augustana with degrees in geology; most of these students did graduate work to the masters level and 26 have received or are due to receive the doctor's degree. Dr. Fryxell also has conducted important research both in this country and abroad.

Paul Fugassi, professor of chemistry at the Carnegie Institute of Technology, has been appointed director of the Coal Research Laboratory. The laboratory recently has been made a part of the Chemistry Department.

Jacob Furth has resigned as head of the Oak Ridge National Laboratory Biology Division's Pathology and Physiology Section to become a staff member of the Department of Pathology, Children's Medical Center, Harvard University. In addition to acting as a consultant to the Center at large, he will be associate director of research at the Children's Cancer Research Foundation and chief of the Experimental Pathology Section.

Friends of **Carl G. Hartman,** associate director of the Ortho Research Foundation, recently presented him with an oil portrait of himself in recognition of his 75th birthday.

Joel H. Hildebrand, emeritus professor of chemistry at the University of California, has been chosen president-elect of the American Chemical Society. President for 1954 is **Harry L. Fisher,** head of the Department of Rubber Technology of the University of Southern California; he succeeds Farrington Daniels, head of the University of Wisconsin Department of Chemistry.

Herbert Knutson, formerly head of the Department of Zoology at the University of Rhode Island, has been named head of the Department of Entomology at Kansas State College, Manhattan. He succeeds **Roger C. Smith** who will devote full time to research.

Marcus D. Kogel, New York City Commissioner of Hospitals since 1949, has resigned his post to become dean of the Albert Einstein College of Medicine. **Abraham White,** formerly of the University of California Medical Center in Los Angeles, will serve as associate dean.

Charles C. Lauritsen, professor of physics at the California Institute of Technology, has been made a Knight Commander of the Danish Order of Dannebrog. The decoration is conferred on persons who perform meritorious services for Denmark, or on Danes living abroad who have made outstanding contributions in diplomacy, science, or the armed services. During the war Dr. Lauritsen served with the National Defense Research Committee and the Office of Scientific Research and Development in Washington and at the California Institute. He was technical director of the Institute rocket project.

Elbert P. Little, former chief of the computation branch, Aeronautical Research Laboratory, U.S. Air Force, has been named technical director of Wayne University's Computation Laboratory.

William F. Mengert, professor of obstetrics and gynecology and chairman of that department in Southwestern Medical School of The University of Texas, has been appointed chairman of the Obstetrics and Gynecology Test Committee of the National Board of Medical Examiners. Appointments to the Board are customarily for a term of six years.

In November the University of Rennes, France, conferred the title (honoris causa) of Docteur de l'Université de Rennes upon **Marston Morse,** professor of mathematics at the Institute for Advanced Study, Princeton.

Effective Jan. 1, **Ralph S. Muckenfuss** became the first full-time scientific director of the Naval Biological Laboratory, which is located at the Naval Supply Center, Oakland, Calif, and is a part of the Department of Bacteriology, University of California, Berkeley. He has been Assistant Commissioner of Health and director of the Bureau of Laboratories of the New York City Department of Health, and is well known for his work in the field of virology.

Dr. Muckenfuss replaces **Albert P. Krueger,** who has served as scientific director on a part-time basis since the establishment of the Office of Naval Research project in 1946 and who also organized the laboratory's predecessors—Naval Laboratory Research No. 1 in 1934, and Namru I during World War II. Dr. Krueger, professor of bacteriology and lecturer in medicine, will become chairman of the Board of Advisors of the laboratory.

Linus Pauling, chairman of the Division of Chemistry and Chemical Engineering at the California Institute of Technology, left in December for a trip around the world during which he will lecture in Greece, Israel, India, and Japan. He expects to return in mid-March.

Anita H. Payne and **Lola S. Kelly,** research fellows engaged in postdoctoral work at the Donner Laboratory, University of California at Berkeley, have received the $2000 Kappa Kappa Gamma Cancer Research Award for outstanding achievement by women in the field of cancer research. The prize-winning paper submitted by Doctors Payne and Kelly was the most recent of a series of joint papers covering their study of postirradiation sensitivity and behavior of malignant tumors.

John Robert Raper, an associate professor at the University of Chicago and on authority on the physiology of fungi, has been appointed professor of botany at Harvard University, effective Feb. 1.

Oscar Riddle, former staff member of the Department of Genetics, Carnegie Institution, has been elected a Fellow of the Royal Society of Arts, London.

W. Roman has been appointed head of the Division of Biochemistry at the Institute of Medical and Veterinary Science in Adelaide, South Australia. He will continue to edit the journal, *Enzymologia.*

Harold L. Rosenthal has succeeded **Joseph V. Fiore** as chief of chemistry at Rochester General Hospital, Rochester, N.Y. In addition to supervising all clinical chemistry, Dr. Rosenthal will conduct research and act as consultant on research projects.

Peter Pen Tieh Sah, whose field is the creation of new drug compounds for animal and human medicine, has joined the faculty of the University of California School of Veterinary Medicine at Davis.

Phil C. Schreier has been appointed acting chief of the Division of Obstetrics and Gynecology at the University of Tennessee College of Medicine and the John Gaston Hospital. Dr. Schreier succeeds **Frank Whitacre** who resigned to join the staff of Vanderbilt University College of Medicine.

William C. Steere, Stanford professor and internationally known botanical expert, has accepted an invitation to serve as president of the Eighth International Botanical Congress to be held at Paris in July, 1954. Dr. Steere recently returned from Alaska where he spent part of the summer studying the distribution

of mosses growing within the Arctic Circle. He will present a paper on chromosome studies of mosses at the Paris meeting.

Education

Officials of the Methodist Church are planning a fund campaign to raise the $1,000,000 needed to build a new liberal arts college in Alaska.

Beginning in February, the American Chemical Society's Philadelphia Section will present two continuation courses, "Petrochemicals" and "Recent Advances in Electrochemistry," at the Philadelphia College of Pharmacy and Science. For further information, address Dr. E. R. Nixon, Harrison Laboratory of Chemistry, University of Pennsylvania, Philadelphia 4, Pa.

The California Institute of Technology has announced that construction is expected to begin next year on a new chemical biology laboratory. Property and funds for the building and for research were bequeathed to the Institute by Norman W. Church.

The second annual Christmas Lectures of the Washington Philosophical Society were presented by Richard M. Sutton, professor of physics at Haverford College. Some 350 to 400 young people attended each of two lectures.

The 1954 Frontiers in Chemistry Lecture Series will be devoted to "Chemistry of the Solid State" and "Chemistry of Natural Products," and will be given at Western Reserve University from Feb. 26 through Apr. 30. Ten outstanding scientists will participate.

In the new seven-story Fritz Engineering Laboratory under construction at Lehigh University, a principle feature will be a testing machine having a capacity of 5,000,000 pounds, and capable of testing actual structural members rather than small replicas.

Television has stimulated public interest in the weather to such an extent that, beginning with the spring semester, New York University will offer an evening course for adult students in "Forecasting the Weather." In addition, the university has announced the removal of technical prerequisites for students who want a course in general meteorology but do not intend to specialize in the field.

To provide an educational visual aid to show the earth floating in space as it would look to an observer approximately 5000 miles away, a revolving globe nearly 28 ft in diameter is being constructed on the campus of the Babson Institute of Business Administration, Wellesley, Mass.

Through funds provided by the National Heart Institute of the National Institutes of Health, Public Health Service, an entire floor in the recently completed Lyon Laboratory Building at the University of Minnesota Medical School has been especially designed for studies in the field of quantitative histo- and cytochemistry under the direction of David Glick, professor of physiological chemistry. The facilities include laboratories for quantitative microchemical analysis of histologically defined samples, optical, x-ray absorption, and histology laboratories, and constant temperature instrument, cold, and animal rooms. Research and training programs will be conducted at both the pre- and postdoctoral levels.

The U.S. Air Force has leased to the University of the South a tract of land and a dwelling on the recently formed Wood Reservoir at the Arnold Engineering Development Center, Tullahoma, Tenn. The university's Department of Biology will establish a biological station on this site. Graduate work in hydrobiology and limnology will be offered under the direction of Professor H. Malcolm Owen, Assistant Professor Harry C. Yeatman, and Assistant Professor Edmund Berkeley.

At a recent dedication of the Dyer Observatory of Vanderbilt University a new type of reflecting telescope developed by James G. Baker of Harvard Observatory was shown. The instrument, called a Baker reflector-corrector, is similar to the wide-angle Schmidt telescope. Photographs taken with a Schmidt, however, have to be on special curved plates. With the new telescope, the optics are so arranged that photographs can be taken on flat plates. The Vanderbilt telescope can also be converted into a conventional instrument by swinging the reflector-corrector lens out of the way and substituting another. Carl K. Seyfert is director of the new observatory, which is located about ten miles south of Nashville. The observatory was made possible through contributions of time, materials, and money by 80 citizens and organizations of Nashville and vicinity. Special grants for the project, totalling $250,000, were received from the Research Corporation and the National Science Foundation.

Grants, Fellowships, and Awards

The College of Forestry of the State University of New York expects to offer 25 fellowships for 1954–55. Stipends vary from $900 to $1350 for a nine- or a twelve-month period. Fellows are excused from paying tuition and laboratory fees of about $350 per year. They are required to assist in teaching and research work for a maximum of 15 hrs per week.

Specially qualified applicants will be considered for other fellowships sponsored by industry, research foundations, and government agencies which the college awards for work on assigned research projects. Recipients are required to devote full time, except for course work, to these projects. Conditions of awards vary with sponsorship. These fellowships carry stipends of from $1500 to $2000. Holders are also excused from paying tuition and laboratory fees.

There is still another group of fellowships that are awarded in relation to the college's general program of research. *Applications should be submitted by Mar. 15.* For detailed information address the Chair-

man, Committee on Graduate Study, State University College of Forestry, Syracuse 10, N.Y.

The **Maria Moors Cabot Foundation** is offering **research assistantships** for graduate study and research in forest genetics. The assistantships will enable students to matriculate in the Harvard Graduate School of Arts and Sciences, and pursue half-time study toward a doctor's degree in biology, while engaged in research. Two assistantships with stipends of $2400 each are available for use in defraying the student's tuition and living costs while in residence at the University. The assistantships will be granted for a single calendar year, beginning July 1. Upon satisfactory completion of the first year of residence, the student will ordinarily be eligible for an equivalent appointment for an additional year.

Graduates of American colleges and scientific schools of good standing, who have completed the normal four-year program leading to a bachelor's degree in one of the plant sciences, and who present evidence of ability to pursue graduate study, will be eligible. Application blanks may be obtained from the Cabot Foundation, Petersham, Mass. *Applications must be filed by Mar. 1.*

Candidates for the $2500 **Merck Graduate Fellowship in Analytical Chemistry** are now being sought for 1954. The fellowship is sponsored each year by Merck & Co., Inc., Rahway, N.J., and administered by the American Chemical Society. The applicant believed capable of contributing most to the advancement of the theory and practice of analytical chemistry during his course of study and in the future will receive the award, contingent upon his acceptance by the institution and professor selected for the proposed study program. The institution selected must be one whose undergraduate course of instruction in chemistry is approved by the American Chemical Society. In Canada, the institution must also be approved by the Chemical Institute of Canada. A student will be eligible to have the fellowship renewed twice. Application blanks may be obtained from the American Chemical Society, 1155 Sixteenth St., NW, Washington 6, D.C. They should be completed and returned to the Merck Fellowship Committee, at the same address, along with letters of recommendation and transcripts of credits. *Deadline date for receipt of all material is Feb. 1.*

Applications for 1954–55 fellowship and grant-in-aid awards of the **National Council to Combat Blindness** will be considered by the organization's Scientific Advisory Committee at its fifth annual meeting to be held this spring. *Completed applications should be received by the Council no later than Apr. 15.* For application forms, address the Secretary, National Council to Combat Blindness (at the Council's new address), 30 W. 59 St., New York 19.

The National Safety Council Award of Honor has been presented to the U.S. Atomic Energy Commission in recognition of the safety record achieved in the atomic energy program during 1952. The award was presented by Ned H. Dearborn, president of the Council, to AEC Chairman Lewis L. Strauss.

During 1952, the frequency of occupational injuries per million man-hours worked in all categories of the program decreased 50 percent below the average for the previous three years, and the severity of injuries was reduced 33 percent; the award was based on this record of improvement.

The injury rate in the atomic energy program has declined steadily since the end of 1949. The frequency of injuries from accidents in the program dropped from 5.40 per million man-hours in 1949 to 2.51 in 1952; the injury rate for American industry decreased from 10.14 to 8.40 per million man-hours during the same period. Construction workers in the atomic energy program incurred 2.71 injuries per million man-hours during 1952—a 61-percent decrease below the 1949–1951 average; this improvement occurred despite an 80-percent increase in AEC construction man-hours in 1952 over 1951.

The **National Science Foundation** will award individual grants to defray partial travel expenses for a limited number of American ornithologists who will attend the **11th International Congress of Ornithology** to be held in Basel, Switzerland, May 29 to June 6. Application blanks may be obtained from the National Science Foundation, Washington 25, D.C. *Completed forms must be submitted by Mar. 1.*

The Nature Conservancy, 607 G St., SE, Washington 3, D.C., is offering a grant of $500 for 1954–55 to any candidate for an advanced degree in a field that allows him to choose as the principal subject of his thesis some aspect of the interrelations between increasing human populations and nature conservation. Applicants should request detailed information from the Conservancy. *Completed forms and a study outline must be submitted before Apr. 15.* The award is made possible through the generosity of Conrad Chapman of Boston, a member of the Nature Conservancy's Board of Governors.

University faculty members are invited to apply for places in the **Research Participation Program** carried out by the **Oak Ridge National Laboratory** and the **Oak Ridge Institute of Nuclear Studies.** Through this program, faculty members may carry out research in Oak Ridge, principally at the National Laboratory, for periods of three months to one year. In general, participation should be for six months or more to be of maximum value both to the faculty member and the laboratory concerned.

Compensation for a person on leave for research participation at Oak Ridge is equivalent to his university salary. Application should be made approximately six months prior to actual participation. Application forms and additional information may be obtained from the University Relations Division, Oak Ridge Institute of Nuclear Studies, P. O. Box 117, Oak Ridge, Tenn.

Eleven of the South's major pulp and paper mills have announced the establishment of the **Reuben B. Robertson professorship in pulp and paper technology** in the School of Forestry at North Carolina State College. The industrial firms have agreed to contribute a total of $5000 a year to the professorship. They also plan other assistance to North Carolina State College's training and research program in pulp and paper technology.

The professorship was set up in honor of Reuben B. Robertson, chairman of the board of the Champion Paper and Fibre Company, Canton. In a brochure announcing the establishment of the new chair, Mr. Robertson was cited for his work in building the pulp and paper industry, now the nation's sixth largest industry. He also was cited for his achievements in the fields of industrial and public relations, in forest conservation, in systematic safety promotion and accident prevention, and for "his life of multiple interests and services," Mr. Robertson joined the staff of the Champion Paper and Fibre Company in 1907 and has been working for the company since that date.

With the distinguished professorship, the School of Forestry will be able to advance its new pulp and paper technology curriculum, the only undergraduate training program of its type in the 14 southern states. The school has been designated as a regional training center for pulp and paper technology by the Southern Regional Education Board in Atlanta, Ga.

A graduate scholarship for **soil moisture research** has been established in the Cornell School of Civil Engineering by Armco Drainage and Metal Products, Inc., of Middletown, Ohio. The stipend will be $2500 a year for a one- or two-year program, beginning with the spring term in February. It will include tuition and funds for field tests. The recipient will also have the use of the school's equipment for measuring soil moisture and density by neutron and gamma ray scattering principles. Information may be obtained from Prof. D. J. Belcher, Department of Transportation, School of Civil Engineering, Cornell University.

The **Tau Beta Pi Fellowships** for graduate study in engineering during 1954–55 have been announced. Each fellowship is for $1200, and its value may be considerably enhanced by remission of most or all of the tuition fees. *Applications must be mailed by Feb. 28.* For additional information write to Paul H. Robbins, Director of Fellowships, 1121 15 St., NW, Washington, D.C.

Meetings and Elections

A new medical group which aims to improve and humanize medical care has been organized with the name **Academy of Psychosomatic Medicine.** Officers are: pres., William Kaufman, Bridgeport, Conn.; v. pres., B. B. Raginsky, Montreal, Canada; sec., Ethan Allan Brown, Boston, Mass.; treas., Alfred J. Cantor, Flushing, N.Y.

Members will be leading surgeons, rehabilitation experts, internists, anesthesiologists, ophthalmologists, gynecologists, obstetricians, psychiatrists, hospital administrators, pediatricians, geriatricians, dermatologists, allergists, and other medical specialists. The work of this organization will be carried out through clinical and laboratory research, medical meetings and forums, and by the creation of a new medical journal.

The **American Ornithologists' Union** has elected the following officers for 1953–54: pres., Alden H. Miller; 1st v. pres., Ludlow Griscom; 2nd v. pres., Ernst Mayr; sec., Harold Mayfield; treas., Charles G. Sibley.

The **American Orthopsychiatric Association** will hold its 31st annual meeting in New York City Mar. 11–13. Approximately 90 scientific papers will be presented by psychiatrists, psychologists, social workers, educators, sociologists, and anthropologists. One section will hold an all-day session on the subject of residential treatment centers for emotionally disturbed children. There will be 18 case workshops, one-and-a-half days of selected mental health film showings, demonstrations of psychodrama, and numerous technical and commercial exhibits.

The presidential session will be concerned with "Causes of Family Breakdown." Papers, symposia, and round tables which follow will be on various orthopsychiatric themes including psychotherapy, child development, psychosomatic disturbances and their treatment, mental health in the schools, and other related subjects. Inquiries about the program, reservations, exhibits, and other matters should be directed to Dr. Marion F. Langer, American Orthopsychiatric Association, 1790 Broadway, New York 19, N.Y.

The National Science Foundation, the Carnegie Institution of Washington, and the California Institute of Technology recently sponsored a **Conference on Radio Astronomy** at the Carnegie Institution. About 30 astronomers and radio engineers attended the three-day conference to discuss current research problems and techniques, including recent developments in antenna design and in the construction of large parabolic reflectors and other receiving equipment. The Conference was organized by the following committee:

J. L. Greenstein, chairman, Mount Wilson and Palomar Observatories
B. J. Bok, Harvard College Observatory
L. A. DuBridge, California Institute of Technology
J. Hagen, Naval Research Laboratory, Washington, D.C.
R. J. Seeger, National Science Foundation
M. Tuve, Carnegie Institution of Washington
J. B. Wiesner, Massachusetts Institute of Technology.

Officers of the **Association of American Medical Colleges** for 1953–54 are: pres., Stanley Dorst, University of Cincinnati College of Medicine; pres.-elect, Vernon Lippard, Yale University School of Medicine; v. pres.,

William Middleton, University of Wisconsin Medical School; treas., John B. Youmans, Vanderbilt University School of Medicine; sec., Dean F. Smiley.

The **Association for Research in Nervous and Mental Diseases** has elected the following officers for 1954: pres., Rustin McIntosh, Columbia University, New York; 1st v. pres., Walter Klingman, University of Virginia; 2nd v. pres., William Langford, Columbia University; sec.-treas., Clarence Hare, Columbia University; ass't. sec., Rollo J. Masselink, Columbia University.

The World Federation for Mental Health has announced the **5th International Congress on Mental Health** to be held in Toronto, Aug. 14–21. The theme of the Congress is Mental Health in Public Affairs. Leaders in the mental health field will present papers of general interest at the plenary sessions. There will be technical sessions, consisting of scientific papers and round-table discussions, supplemented by smaller discussion groups.

The International Association for Child Psychiatry will hold an International Institute on Child Psychiatry on Aug. 13–14 in conjunction with the Congress. The subject will be Emotional Problems of Children under Six. Members of the Institute will discuss prepared clinical case studies and research reports related to the treatment of young children. It is hoped that some broad principles of child psychiatry will emerge which will be useful to workers in this field.

It is anticipated that many nationalities and professional groups will be represented at the Congress. The National Association for Mental Health would like to insure the attendance of a large group from the United States. For further information communicate with Helen Speyer, National Association for Mental Health, 1790 Broadway, New York 19, N.Y.

An honorary food technology society, **Phi Tau Sigma**, was founded on Dec. 1 by a group at the University of Massachusetts. The organization will be incorporated under the statutes of the Commonwealth of Massachusetts, with headquarters remaining at the University. It is intended that charters will be granted for the establishment of local chapters in other areas in accordance with the procedures promulgated in the constitution of the Society.

The purposes of the organization are to "encourage the application of fundamental science to food technology, to honor and recognize achievements in the field and to promote fellowship, thereby stimulating the free exchange of knowledge in food technology." These goals will be carried out through an active program of lectures, discussion meetings, and social gatherings by chapters as well as by the election to membership of qualified food technologists and advanced students of food technology.

Elected to the board of directors of the Society were: Milton P. Baldauf, Robert V. Decoreau, Enio Feliciotti, Gideon E. Livingston, William D. Powrie, Maynard A. Steinberg, and Donald E. Westcott. Gideon E. Livingston, associate research professor of food technology, was elected chairman of the board of directors and president of the Society for 1954. William D. Powrie, research instructor in food technology, was elected vice-president. Enio Feliciotti, instructor in food technology, is secretary-treasurer and Mr. Donald E. Westcott, instructor in food technology, is appointed executive secretary. In recognition of his numerous contributions to food technology, Carl R. Fellers, head of the Department of Food Technology at the University of Massachusetts, was elected honorary president.

Miscellaneous

New journals received: ***Actas de la Clinica Yódice*** (In Spanish.) Núm. 1, Año 1, July–Aug. 1953. Director, José Raúl Vásquez. Clínica Yódice, Canning 2904, 5° C, Buenos Aires, Argentina. Bi-monthly. $5.00 per year. . . . ***Boletín Indigenista Venezolano*** (In Spanish.) Vol. 1, No. 1, Jan.–March 1953. Comisión Indigenista, Ministerio de Justicia, Apartado 2.059, Caracas, Venezuela. Quarterly. . . . ***Bulletin of the Chinese Association for the Advancement of Science*** (In English.) Vol. 1, No. 1, Aug. 1953. Editor, Tsao Wen-yen. CAAS, 59 Kuan Chien Road, Taipei, Taiwan, China. $6.00 per year; 70¢ per issue. Monthly. . . . ***Bulletin of the Institute of Nuclear Sciences "Boris Kidrich"*** (In English.) Vol. 3, Aug. 1953. Formerly published as **Recueil de Travaux de l'Institut de Recherches sur la Structure de la Matière.** P. O. Box 522, Belgrade, Yugoslavia. . . . ***Deep-Sea Research.*** Vol. 1, No. 1, Oct. 1953. Pergamon Press, 242 Marylebone Rd., London, N.W.1., England. Quarterly. £4 10s. a volume incl. postage. . . . ***General Motors Engineering Journal.*** Vol. 1, No. 3, Nov.–Dec. 1953. Editor, Arvid F. Jouppi. General Motors Corp., 3044 W. Grand Blvd., Detroit 2, Mich. Bi-monthly. . . . ***Journal of the Operations Research Society of America.*** Vol. 1, No. 5, Nov. 1953. Editor, Thornton Page. Operations Research Society of America, Mount Royal & Guilford Aves., Baltimore 2, Md. Quarterly. $1.50 per issue; $6.00 per year ($6.60 outside U.S. and Canada). . . . ***Oceanus.*** Vol. 1, No. 1, Winter 1952. Editor, Jan Hahn. Woods Hole Oceanographic Institution, Woods Hole, Mass. Semiannually. Free. . . . ***La Revue Libérale*** (In French.) (Science, philosophy, economics.) No. 4, Oct.–Dec. 1953. Director, M. Rouillard. 1, rue François I^{er}, Paris-8^{e}, France. Quarterly. 700 frs. a year. . . . ***Wakayama Medical Reports*** (In English.) Vol. 1, No. 1, May 1953. Founded by Yashiro Kotake. Wakayama Medical College, Japan. . . . ***The Yokohama Mathematical Journal*** (In English.) Vol. 1, No. 1, May 1953. Editor, T. Takasu, Yokohama Municipal University, Kanazawa-Hakkei, Yokohama, Japan. Semiannually.

Correction: The note on Roger Adams in "Scientists in the News" of Jan. 8th should have stated that Dr. Adams is to receive the Perkin Medal of the American Section of the Society of Chemical Industry, not the medal of the American Section of the Société de Chimie Industrielle. *Science* regrets the error.

Technical Papers

Nonspecificity of the Triple Response for Ethylene[1]

Paul E. Waggoner and A. E. Dimond

Department of Plant Pathology and Botany, The Connecticut Agricultural Experiment Station, New Haven

The present note discusses the validity of the triple response of etiolated pea seedlings as a measure of gaseous ethylene production by living material. The triple response has been used frequently by physiologists as a measure of ethylene production by ripening fruit, by fungi, and by injured and healthy plant tissues. The evidence presented below suggests that when ethyl alcohol is also produced by living material, as with certain fungi, the triple response is unreliable as a specific detector of ethylene.

Living plant tissues may not only produce ethylene but also may be affected by it in very low concentration. Tomatoes respond epinastically to concentrations of ethylene in air as low as 0.1 ppm by volume and epinastic responses are shown by African marigold to concentrations of 0.001 ppm (*1*). Chemical methods for determining ethylene will usually not detect such low concentrations unless considerable quantities of material are available. For this reason bioassays for ethylene have been developed. The most commonly employed of these is the triple response of etiolated Alaska pea seedlings in which concentrations of ethylene as low as 0.05 ppm will induce a shortening of the epicotyl, a curvature of the apical plumule, and an increase in diameter of the epicotyl (*2, 3*). At very low concentrations only the epicotyl is shortened; at higher concentrations all three responses appear (*1*). The triple response is a quantitative test for ethylene, and has come to be widely accepted as a specific detector of ethylene arising from living material (*4*).

Certain materials that affect the growth of plants will not interfere with the triple response test. Gases such as acetylene, propylene, and carbon monoxide can be detected by the triple response in concentrations as low as 250, 1000, and 5000 ppm, respectively (*1*). These gases do not arise from living material, however. The known natural plant hormones other than ethylene are nonvolatile from plants and cannot interfere because of the manner in which the test is set up. However, volatile compounds other than ethylene arise from living material and the reliability of the triple response as a specific indicator for ethylene depends upon a demonstration that volatile compounds other than ethylene do not elicit the triple response in etiolated pea seedlings.

In recent studies dealing with the production of ethylene by the fungus *Fusarium oxysporum* f. *lycopersici*, it became necessary to measure the production of ethylene in the presence of ethyl alcohol. To determine whether or not ethyl alcohol affects the triple response, etiolated pea seedlings were exposed to alcohol vapor. Alaska peas[2] were soaked overnight in distilled water and were then transferred to filter paper sheets in Petri dishes, 75 seeds per dish. The dishes were watered with saturated $CaSO_4$ solution and were then placed in a dark cupboard at room temperature for 2 days. At the end of this time the 50 most uniform germinating seedlings were left in the dishes, the others were discarded. One Petri dish containing seedlings was placed in each of three empty desiccators (2.1 l capacity), containing 100 ml of water or alcohol solution, ranging in concentration from 0.1 to 1.0% by volume. Desiccators were then closed and placed in a dark cupboard for 3.5 days. At the end of this time the length and diameter of epicotyls and the angle of curvature of the growing point were measured. Epicotyl lengths were then converted to logarithms, whereas plumule angles and epicotyl diameters were not transformed before statistical analysis.

TABLE 1. Response of etiolated pea seedlings to ethyl alcohol vapor.

Concentration of alcohol (%)	Logarithm of epicotyl length (log mm)	Angle of plumule (deg)	Diameter of epicotyl (mm)
0.0	1.17	99	2.52
0.1	0.86	87	2.58
1.0	0.60	66	2.51
Least significant mean difference (P: 0.05)	0.06	12	0.10

Exposure to ethyl alcohol significantly reduced the length of pea epicotyls and the angle between the plumule and the epicotyl below (Table 1). These are the two responses commonly used by investigators to indicate a positive triple response. This result has been confirmed in repeated experiments.

Ethyl alcohol is frequently formed in biological material under circumstances where ethylene might be expected to occur. In the present study it was found that *Fusarium* produces both ethylene and ethyl alcohol in culture (*5*). Ripening fruit also produces both compounds simultaneously (*6*). Apparently where ethyl alcohol may be present, the triple response of etiolated peas cannot be used as a reliable indicator for the presence of ethylene.

When ethyl alcohol may be present, ethylene can be detected in a number of ways. Tomatoes respond epinastically in the presence of 0.1 ppm ethylene (*1*).

[1] Conducted under Contract AT-(30-1)-580 between the Atomic Energy Commission and The Connecticut Agricultural Experiment Station.

[2] Supplied through the courtesy of Associated Seed Growers, New Haven, Conn.

In the present study, tomato cuttings exposed to alcohol vapor arising from solutions of alcohol ranging from 0.1 to 95% by volume did not respond epinastically. A safer method involves the quantitative manometric method in which ethylene is trapped by mercuric perchlorate and released again with hydrochloric acid (*7*). This method may not be sufficiently sensitive for measuring very small quantities of ethylene. In such a case, it has been found satisfactory to trap the ethylene in mercuric perchlorate solution and to release it again in a closed vessel of small volume in which tomato plants are confined (*5*). The epinastic response of these plants will then be specific for ethylene if the gas arose from biological materials or did not contain other unsaturated hydrocarbons. Alternatively, the triple response can be used as a quantitative measure of the ethylene released from perchlorate solution on addition of hydrochloric acid.

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Successful Transplantation of an Apparently Benign Neoplasm

Robert H. Foulkes[1]

Edsel B. Ford Institute for Medical Research, Henry Ford Hospital, Detroit, Michigan

A spontaneous mammary pericanalicular fibroadenoma developed in a female albino rat of the Sprague-Dawley strain. Grossly the tumor was a hard, white, homogeneous, lobulated, encapsulated, palpable mass. Six months after complete removal, no recurrence was indicated.

As indicated in the treatise by Greenstein (*1*), some investigators consider benign tumors incapable of further growth by transplantation. Small pieces of the present tumor, 2 ml thick by 3–4 ml in diameter, were implanted subcutaneously along the milk line of albino female rats. Of the transplants, 4 of 4 in the first, 5 of 6 in the second, 6 of 8 in the third, and 3 of 4 in the fourth generation continued to grow into large tumors. Increase in the size of transplant was not evident for 4–7 wk after transplantation. If no increase was evident after 8 wk, no growth occurred later. Histology of the tumors remained the same in each generation.

Transplantations into 4 male rats and 4 female mice (Webster albino) have been unsuccessful. Transplantation by injection of macerated suspensions of the tumor have so far failed. The transplantations are being continued. Any significant change in the appearance or behavior of this tumor will be reported.

[1] Adelaide Skinner Fellow in Cancer Research.

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Circular Paper Chromatography II. Isatin as a Color Reagent for Amino Acids

Abraham Saifer and Irwin Oreskes[1]

Biochemistry Department, Division of Laboratories, Jewish Sanitarium and Hospital for Chronic Diseases, Brooklyn, New York

In a previous publication (*1*), studies were presented of the physical factors that may influence R_f values for the circular chromatographic method (*2, 3*). Among the advantages of this method is the possibility of cutting the chromatogram into a number of segments and using various color producing reagents for each segment. Thus, it is possible to identify an individual amino acid in a band containing several other amino acids by means of *specific* color reactions. A number of such specific reagents which give colors with one or several amino acids have been mentioned in the literature (*4, 5*). This is in contradistinction to the use of ninhydrin (*6–8*) as the coloring reagent "par excellence" which gives purple or blue colors with virtually all the amino acids found in protein hydrolyzates. Exceptions to this color reaction with ninhydrin are the imino acids, proline and hydroxyproline, which give faint yellow colors. It was for this reason that Acher, Fromageot, and Jutisz (*9*) first proposed the use of isatin in *n*-butanol-acetic acid solution as a highly specific reagent which gives intense blue-green colors for proline and hydroxyproline on paper chromatograms. Their use of this reagent is based upon the experimental studies of Grassmann and Arnim (*10, 11*) on the reaction of isatin with pyrrole ring compounds to give colored products.

The chemistry of isatin is discussed in the textbook of Morton (*12*) and in a review paper by Sumpter (*13*). These sources point out that isatin reacts with both imines and amines to form products which in many cases are colored. However, only sporadic references were found to the reaction of isatin with amino acids in general (*14, 15*). Although isatin is now generally used as a specific reagent for the identification of proline and hydroxyproline on paper chromato-

[1] The authors wish to acknowledge the aid of Dr. Bruno W. Volk, Director of Laboratories, who permitted part of the experimental work in this paper to be performed under Grant No. B-285 of the U.S. Public Health Service dealing with the general subject of "Protein Studies in Chronic Diseases." We also wish to thank Miss Renee Eisner for editing and typing the manuscript.

grams (*16–18*), Block (*16*) has noted that upon heating the chromatogram a number of other amino acids give color reactions with isatin. However, Block (*16*) has not stated which particular amino acids react with isatin and the limits of sensitivity of such reactions.

This paper deals with the reaction of isatin with various amino acids, the colors obtained, and the limits of sensitivity of such reactions. We have found this reagent most useful for the qualitative identification of a number of amino acids, with the circular chromatographic technique (*1*).

In the experimental work, various amounts of the amino acids listed in Table 1 were spotted on Whatman No. 1 filter paper so that each spot was 1 cm in diameter. The filter paper was dried at room temperature and then dipped into a solution of isatin (0.2% in acetone containing 4% acetic acid), dried for several minutes in air and then heated for 10 minutes at 100°. Twelve out of twenty-one amino acids tested gave distinct color reactions. It can be seen from the data in this table that a number of other amino acids besides proline and hydroxyproline give blue or blue-green colors with isatin. The approximate lower limits of sensitivity for the reacting amino acids are shown in the last column of Table 1.

TABLE 1. Reactions of various amino acids with isatin.

Amino acid*	Color	Approximate lower limits of sensitivity (μg)
1. Proline	Blue	< 1
2. Phenylalanine	Blue-green	1
3. Tyrosine	Blue-green	1
4. Tryptophan	Blue-green	1
5. Hydroxyproline	Blue-green	2
6. Glutamic acid	Lavender	2
7. Lysine	Lavender	2
8. Arginine	Lavender	2
9. Methionine	Blue-green	2
10. Histidine	Blue	2
11. Aspartic acid	Blue	5
12. Cystine	Blue-gray	5

* The following amino acids gave no appreciable color with isatin in amounts of 10 μg or less: glycine, serine, alanine, valine, threonine, leucine, isoleucine, glutamine, asparagine.

The usefulness of isatin as a color reagent for amino acids is apparent when an amino acid mixture, for example protein hydrolyzate, is run with the circular chromatographic technique employing phenol as the developing solvent (*8*) in an atmosphere of 0.1% ammonia. In this case, tyrosine-alanine and valine-methionine travel together as pairs. The presence of tyrosine and methionine, respectively, can be shown by removing a segment of the chromatogram and carrying out the isatin color reaction. The application of the isatin reaction to the identification of amino acids separated by other solvent systems has been employed extensively in this laboratory. Subsequent publications will deal with the use of this reagent for the qualitative and quantitative determination of the amino acids present in various biological fluids, for example protein hydrolyzates.

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Distemper Immunization of Ferrets by Nebulization with Egg Adapted Virus[1,2]

John R. Gorham, R. W. Leader,[3] and Joyce C. Gutierrez

Bureau of Animal Industry, U.S. Department of Agriculture and State College of Washington, Pullman

Living Newcastle disease vaccines have been administered to chickens by inhalation (*1*). The results indicate that airborne inoculation may be employed as a means of preventing the disease. The purpose of this investigation was to determine whether ferrets could be protected against virulent distemper virus (DV) through the use of this method. Ferrets were exposed to egg-adapted DV as an aerosol at definite intervals prior to a given time when all ferrets were challenged with virulent virus.

The virus suspensions for nebulization were prepared from infected chorioallantoic membranes (CAM's) of the 90th passage level of the *Onderstepoort* strain of egg-adapted DV (*2*). Seven-day-old chicken embryos were inoculated on the CAM with 0.1 ml of seed virus. After a further incubation of 7 days the CAM's were harvested and ground in a Waring Blendor with diluent to make a 10^{-1} suspension of infected membranes. The diluent was 10% horse serum in nutrient broth (Difco) with each milliliter containing 500 units of crystalline penicillin G and 500 μg of

[1] Scientific Paper No. 1263, Washington Agr. Expt. Sta.

[2] Before these studies were completed, J. A. Crawley of the University of Toronto kindly made available information which shows that mink can be protected against distemper by using the same principle as the one herein reported.

[3] Department of Veterinary Pathology, State College of Washington, Pullman.

TABLE 1. The results of aerosol exposed ferrets to challenge with virulent distemper virus.

No. of ferrets in group	Date of aerosol exposure	No. of days before challenge	Day after challenge	
			Onset of signs	Death
2	8/ 9/53	32	—	—
			—	—
1	8/17/53	24	—	—
1	8/25/53	16	—	—
1	9/ 1/53	9	—	—
2	9/ 3/53	7	—	—
			—	—
2	9/ 5/53	5	—	—
			—	—
2	9/ 6/53	4	—	—
			14	20
2	9/ 7/53	3	14	Recovered
			13	21
2	9/ 8/53 (A.M.)	2	8	12
			9	12
2	9/ 8/53 (P.M.)	1.5	8	9
			8	11
2	9/ 9/53 (A.M.)	1	8	10
			9	11
2	9/ 9/53 (P.M.)	0.5	8	11
			10	12
2	9/10/53	0*	8	10
			9	11
2	9/11/53	−1	8	10
			9	11
2	Nonexposed controls		8	10
			9	11

* Simultaneous aerosol exposure and challenge virus.

dihydrostreptomycin sulfate. This dilution, which was used as the aerosol inoculum, was stored at −20° C until used. The inoculum was standardized by a titration, consisting of serial 5-fold dilutions of virus. The 50% infective dose (ID_{50}) per 0.1 ml of inoculum in chicken embryos was $10^{3.6}$.

The aerosol was produced by a DeVilbiss 40 type nebulizer operated at 3 lb pressure. The orifice of the nebulizer was fitted into a hole in one side of a chamber which measured 9×6×6 in. Approximately 0.3 ml of inoculum was nebulized into the chamber during each minute of operation. Young distemper susceptible ferrets were confined to the chamber for 3 min, the first 2 min of which the nebulizer was in operation.

The challenge virus was prepared by inoculating 2 ferrets intramuscularly with the contents of one ampoule of canine distemper vaccine (Distemperoid), Serial 174-A, which was supplied through the courtesy of Fromm Laboratories. The ferrets became moribund on the 11th day following inoculation and were sacrificed. Their spleens were removed and a 20% W/V suspension in nutrient broth was prepared. One ml of the challenge virus was given intramuscularly to each of the ferrets at intervals ranging from −1 to +32 days after exposure to the aerosol inoculum (Table 1). The appearance of conjunctivitis, nasal exudation, dermatitis, or the demonstration of DV inclusion bodies was considered the criterion of infection.

Data obtained from this preliminary experiment indicate that resistance to virulent DV can be stimulated by aerosol exposure to a living egg-adapted virus. Under the conditions of this experiment, the onset of resistance following airborne inoculation of the *Onderstepoort* strain occurred at 5 days. In a previous investigation it was shown that ferrets which were vaccinated intramuscularly with the same strain of egg-adapted virus 2 or more days prior to challenge did not develop distemper (*3*).

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Influence of Water-Soluble Vitamin E on Survival Time in Irradiated Mice[1]

Thomas J. Haley, Eve F. McCulloh, and W. G. McCormick[2]

Division of Pharmacology and Toxicology, Atomic Energy Project, School of Medicine, University of California, Los Angeles

One of the current theories used in explaining the deleterious effects of ionizing radiation in animals is based upon the formation of peroxide by the action of the radiation on aqueous solutions (*1*). Mead (*2*) has shown that x-irradiation induces organic peroxide formation in linoleic acid, resulting in a chain reaction which destroys this essential fatty acid. More recently, Polister and Mead (*3*) found that *d*-γ-tocopherol was capable of protecting methyl linoleate from radiation-induced autoxidation *in vitro*. If it could be shown that this naturally occurring antioxidant was effective *in vivo*, progress would be made in radiation therapeutics. Furth, Coulter, and Howland (*4*) administered α-tocopherol in oil to rats prior to irradiation without beneficially influencing their survival time. However, Ames, Baxter, and Griffith (*5*) showed that oil-soluble vitamin E (61% α-tocopherol) decreased petechial hemorrhages of the mesentery in rats subjected to injection of radon ointment in the abdomen. These differences in results may have been due to differences in the type of irradiation used (gamma vs alpha) or to the failure of the oil-soluble material to be absorbed and become available as a tissue antioxidant. The tissue availability of the antioxidant is of greatest importance at the time of initial injury and throughout the first two postirradiation weeks if the peroxide chain reaction is to be prevented or stopped. Injections of water-soluble vitamin E would make available to the animal a natural antixodant

[1] Based on work performed under contract No. AT-04-GEN-12 between the Atomic Energy Commission and the University of California at Los Angeles.

[2] We wish to thank Distillation Products Industries for the water-soluble vitamin E used in this investigation.

which should be beneficial in counteracting the deleterious effects of irradiation.

Male CF 1 strain mice, weighing an average of 20 g, were arranged in groups of 20 animals each and maintained under the same conditions used in our previous radiation studies (*6*). The water-soluble vitamin E solutions and control saline were injected intramuscularly in total daily doses of 0.1 ml of the concentrations given in Table 1. Injections were given prior to irradiation and every day thereafter until 90–100% of the animals had died. The 550-r irradiation dose was administered from above and below the mice with two 250 KVP Picker Industrial Units operating simultaneously. The technical factors were: 250 KVP; 15 ma; FOD 100 cm; filters 0.21 mm Cu inherent, 0.5 mm Cu parabolic, and 1.0 mm Al; HVL, 2.02; size of field-total body, r/min measured in air 17.37–17.53. Both units were calibrated prior to the experiment with a Victoreen thimble r-meter. The results obtained were analyzed statistically by the method of Litchfield (*7*).

The results obtained are given in Table 1. It is evident that the lower doses of vitamin E neither significantly increased nor decreased the ST_{50} day or the day of total mortality, whereas the two highest doses significantly decreased both. These results indicate that even when this antioxidant is made available to the animal prior to irradiation and throughout the post-irradiation period, it does not prevent the deleterious effects of ionizing radiation. The doses used should have been adequate, because Polister and Mead (*3*) showed that *in vitro* 2.69×10^{-5} *M* tocopherol would prevent radiation-induced oxidation of 2.56×10^{-2} *M* methyl linoleate. The fact that the higher doses of vitamin E increased both the rate of mortality and the total mortality would indicate that the vitamin acted synergistically with the radiation. This confirms Mead's (*8*) observation with fat-soluble vitamin E in rats. Such effects indicate that the extensive biochemical derangements which occur in the radiated animal may make otherwise nontoxic doses of essential metabolites a contributing factor in lethality from radiation. It is also possible that even water-soluble vitamin E does not reach the site of peroxide action, and thus the peroxides are not prevented from exerting their deleterious effects. On the other hand, peroxide formation is only one effect produced by radiation, and therapy designed to counteract only one damaging effect might not prevent over-all radiation damage.

TABLE 1. Effect of water-soluble vitamin E in irradiated mice.

Drug	Total daily dose (mg)	ST_{50}* and range (days)	Slope and range	Total mortality (Days)	Total mortality (%)
Saline 0.9%	—	8.35 (7.3–9.5)	1.35 (1.2–1.5)	12	90
B-883 Vitamin E based on 25.5% α-Tocopherol content	0.5	9.4 (8.6–10.3)	1.23 (1.15–1.31)	11	100
	1.0	7.95 (7.2–8.7)	1.24 (1.16–1.33)	11	95
	2.0	5.8 (5.5–6.13)	1.13 (1.08–1.17)	8	100
	3.18	4.21 (3.9–4.5)	1.19 (1.13–1.26)	6	100

* ST_{50} = day on which 50% of animals remain alive. Values are at odds 19/20.

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Root Production in Plants Following Localized Stem Irradiation[1]

Eric Christensen[2]

Biology Department, Brookhaven National Laboratory, Upton, New York

This paper reports the induction of adventitious roots in *Xanthium, Nicotiana, Lycopersicum,* and *Phaseolus* following localized irradiation of a small length of the stem of the intact seedlings.

Adventitious roots have been produced artificially in the past in a number of intact plants as a response to various external treatments. The use of auxin pastes is well known. Ethylene, propylene, and acetylene have also been used to produce roots on the stems of *Lycopersicum, Tagetes, Nicotiana, Hydrangea,* and *Coleus* (*1*). Carbon monoxide has produced the same effect in *Cosmos, Impatiens, Amaranthus,* and other plants (*2*). Root development on bean cotyledons followed planting of the seed in soil treated with 2-4-D (*3*). Johnson, using x-rays, reported some increased rooting in *Salix* cuttings but concluded that radiation was harmful to the rooting of herbaceous cuttings (*4*).

The present study was conducted with seedling plants exposed to 250 KVP, 30 ma x-irradiation with 1 mm Al filtration. Lead shielding 2 cm thick was placed so as to protect all plant parts except the short length of stem to be irradiated. The epicotyl and hypocotyl respond similarly to this treatment; no distinction was made between these regions in selecting the site of treatment. Cotyledons were often included in the exposure.

[1] Research carried out at Brookhaven National Laboratory under the auspices of the United States Atomic Energy Commission.

[2] The author wishes to thank Dr. A. H. Sparrow for providing facilities which made the work possible and Dr. Seymour Shapiro for valuable suggestions made in the course of the investigations.

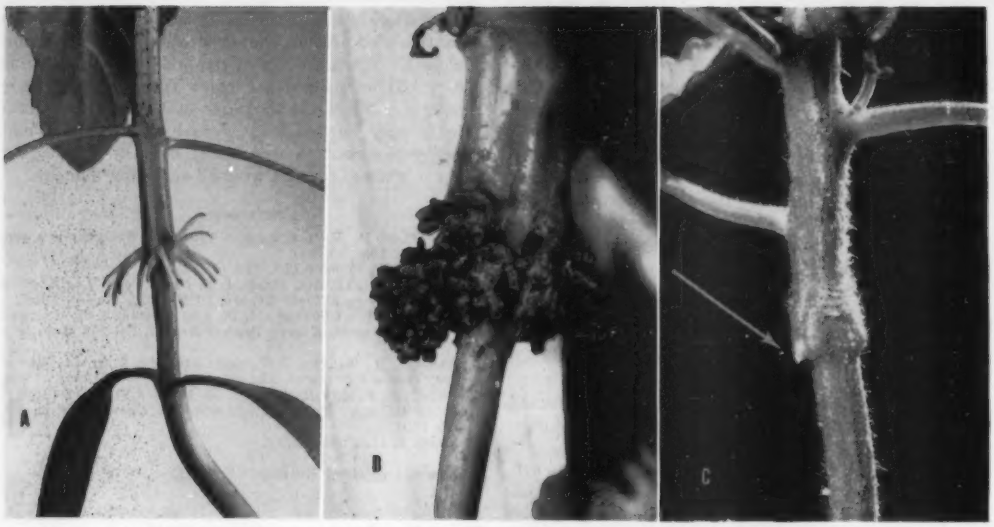

FIG. 1. A. *Xanthium*, 29th postradiation day (1500 r) roots evoked by 3 days of high humidity. B. *Xanthium*, 90th postradiation day (3000 r) ultimate root development without high humidity. C. *Lycopersicum*, 27th postradiation day (24,000 r); arrow indicates young root in swollen region above irradiation site.

The rooting response has been studied chiefly in cocklebur (*Xanthium* sp.). It does not occur at dosages of 1000 r or less but does result unfailingly in all plants receiving 1500 r to 12,000 r. A stem sector of *Xanthium* irradiated with such an effective dosage shows no visible effect for about 2 wks, when a slight chlorosis of the irradiated zone appears. At about 3 wks, the irradiated zone is decidedly narrower than the regions above and below it, apparently because growth is slower there than in the unirradiated parts of the stem. Some swelling occurs in the untreated part of the stem immediately above the irradiated area. In the fourth postradiation week, the swollen region displays small papules which develop into normal roots if a sufficiently humid environment is provided (Fig. 1A). The plant may be air-layered or kept in a moist hood to evoke the roots on the intact plant, or it may be decapitated through the irradiated region and handled as a rooted cutting. Roots will develop sufficiently in a few days, in any of these cases, to support the plant independently.

If the plant is not subjected to high humidity as described, the young rootlets will be produced in greater numbers but will stop growth and become suberized at a length of a few mm. The ultimate development of such growth is shown in Fig. 1B.

Other species and the dosages which have produced rooting in this manner are: *Nicotiana glauca*, 6000 r; *Lycopersicum esculentum*, 24,000 r (Fig. 1C); *Phaseolus* sp., 16,000 r. No lower limits of effectiveness have been determined for these species.

The mechanism of this response is being investigated. The gross aspect of the plant suggests that a phloem block occurs at the radiation site which impairs downward transport beyond that point. An accumulation of the organic materials carried by the phloem would thus occur above the irradiated area. This could readily explain the swelling which takes place, as well as the induction of roots from the swollen region. At the same time, the upward transport of water through the radiation site seems unaffected, since the plant above this area displays no signs of wilting. Localized irradiation, as described, did not seem to interfere with height growth during the time required to produce the adventitious roots.

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Antithyroid Action of Antibiotics[1]

B. Calesnick,[2] W. D. Harris, and R. S. Jones

Department of Pharmacology,
Hahnemann Medical College, Philadelphia, Pennsylvania

The significant increase in body weight of poultry and swine following the addition of minute amounts of antibiotics to their normal diets has served to bring into prominence the role of antibiotics in animal nutrition (*1–4*). It was considered of interest to com-

[1] This investigation was supported in part by a grant from the committee on Therapeutic Research, Council on Pharmacy and Chemistry, American Medical Association.

[2] On military leave of absence.

pare the action of antibiotics and thiouracils under identical conditions on the thyroid gland.

A colony of immature white rats, approximately 45 days old, was divided into 5 groups of 4 animals each. The groups received the same basic diet (Pratts Nurishmix with 1% iodized salt). Exclusive of the control, each group received their drug by blending it into the ground food in the following concentrations: aureomycin or potassium penicillin G, 1 mg/kg; iodothiouracil (Itrumil) or propylthiouracil, 2%.[3] The animals were permitted to eat ad libitum for 42 days and were weighed weekly. A dose of 20 μc I^{131} was injected iv into these animals exactly 48 hours before the conclusion of this experiment. Following this, the rats were sacrificed, the radioactive count obtained, and the thyroids studied histologically.

It was observed that the thyroid/total body weight ratio as well as the uptake of I^{131} compared favorably (Table 1). All the test groups showed an increase in

TABLE 1.

	Comparative size of thyroid glands (% total body wt. $\times 10^{-4}$), av.	Uptake of I^{131} by thyroids (cpm/mg tissue)	
		Av.	% control
Control	1.94 ± 0.48	543 ± 47	100
Potassium penicillin G	3.73 ± 0.51	149 ± 41	27.4
Aureomycin	7.63 ± 1.03	115 ± 23	21.1
Itrumil	23.5 ± 4.8	0.7 ± 0.2	0.12
Propylthiouracil	41.5 ± 7.9	58 ± 16	10.6

size of the thyroid and a marked depression of the uptake of I^{131}. However, the changes induced by the antibiotics were not as great as by the thiouracils. Histologically, in one of the aureomycin-fed rats, there was evidence of hyperplasia; no changes were observed in the penicillin-fed group. In addition, the vascularity after Itrumil was far less than after propylthiouracil thus confirming the observations of other investigators (*5*).

In our observations, there is suggestive evidence that aureomycin and potassium penicillin G have a goitrogenic action which simulates the thiouracils. It is of major interest to note that it has been suggested that pharmacologically thiouracils disturb uracil metabolism (*6, 7*) and that penicillin disturbs nucleic acid synthesis (*8*). Although limited data have been presented, there is evidence that aureomycin and potassium penicillin G inhibit thyroid activity as measured by the uptake of I^{131} and the weight of this gland.

[3] We wish to thank the Ciba Pharmaceutical Products, Inc., for their generous supply of Itrumil, and Wyeth, Inc., for the potassium penicillin G.

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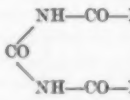
Production of Triuret from Uric Acid by Ultraviolet Irradiation[1]

Josef Fellig[2]

Department of Physiology,
Tufts College Medical School, Boston, Massachusetts

As part of a program involving the relation of the chemical and biological effects of the irradiation of nucleic acid derivatives (*1, 2*), uric acid has been irradiated with ultraviolet light. This paper deals with the production in this manner of triuret, which is not known to be produced under physiological conditions.

Two-liter portions of uric acid solution in water (0.1 mg/ml, pH adjusted to 6.5) were irradiated at room temperature for 2 hr in large white enamel pans by batteries of 7 G.E. germicidal lamps placed about 1 cm above the surface of the solution. The specific ultraviolet absorption spectrum of uric acid had completely disappeared by that time. The solution was concentrated *in vacuo* at 35–40° C and placed in the refrigerator. A yellow crystalline precipitate was formed which was filtered off and recrystallized four times from boiling water. The substance crystallizes in colorless leaflets. It is insoluble in ether and chloroform, sparingly soluble in cold water and ethanol, and soluble in alkalis, acids, and boiling water. It does not show an ultraviolet absorption spectrum. On heating in 1*N* NaOH solution, ammonia is liberated. The substance has the following composition: C, 25.00%; H, 4.09%; N, 38.49%.[3] This checks well for an empirical formula of $C_3H_6N_4O_3$: C, 24.5%; H, 4.1%; N, 38.4%. This and the solubility characteristics suggested to us that the substance might be triuret (1,3-dicarbamylurea):



The melting point of the substance after prolonged drying in high vacuum at 50° C is 237° C when determined in a sealed capillary tube. This is in good accord

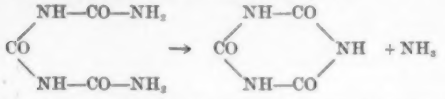
[1] Done under terms of contract No. AT(30-1)911 with the Atomic Energy Commission.

[2] Present address: Division of Biochemistry, Massachusetts Institute of Technology, Cambridge, Mass.

[3] All analyses were carried out by C. Tiedcke, Teaneck, N. J.

with the values of 231–235° reported for triuret (*3, 4*).

When triuret is heated in contact with air or in solution in 1*N* NaOH, it is transformed into cyanuric acid with elimination of ammonia (*5, 6*):

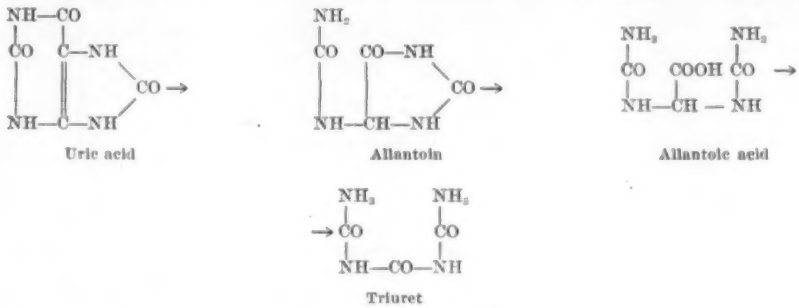


Under both conditions our substance formed cyanuric acid which was identified by the crystalline amethyst-colored precipitate which is formed when a solution of ammoniacal cupric oxide is added to a solution of cyanuric acid (*7, 8*).

We then prepared a sample of triuret by the method of Schittenhelm (*9*)—oxidation of uric acid in ammoniacal solution by hydrogen peroxide. The three times recrystallized triuret had the following composition: C, 24.55%; H, 4.25%; N, 38.43%; it gave a melting point of 235°. On mixing our substance and this triuret, the same melting point was obtained.

We wanted to characterize our substance further but found that none of the usual amide derivatives had been prepared from triuret. We chose xanthydrol as a reagent because it is frequently used to characterize urea. The directions of Phillips and Pitt (*10*) were followed with the exception that the reaction mixture was heated on the steam bath rather than at 85° C, in order to dissolve the triuret. The product was recrystallized from a dioxane-water (2 : 1) mixture and dried in high vacuum at 50° C (analysis: found C, 68.81%; H, 4.68%; N, 11.01%; calculated for $C_{29}H_{22}O_5N_4$: C, 69.0%; H, 4.4%; N, 11.00%). The melting point was 279° C. The same derivative was prepared from the authentic triuret and showed a melting point of 277° C.

From the preceding results it appears that the substance which has been isolated from irradiated uric acid is triuret. We can only speculate as to the mechanism of its formation and suggest that a possible pathway could be through allantoin to allantoic acid which could be decarboxylated and oxidized to triuret:



The yield of triuret corresponds to about 10% of the uric acid; this is a sizable amount in view of the considerable simultaneous formation of ammonia and urea (*2*). We have evidence that other products are being formed in addition to triuret, which we have not yet been able to isolate and characterize except for cyanuric acid, whose presence has been detected in small amounts in the irradiated solution by the above mentioned reaction.

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Comments and Communications

Zoological Nomenclature: Decisions Taken by the Fourteenth International Congress of Zoology, Copenhagen, August, 1953

THE Fourteenth International Congress of Zoology, which met at Copenhagen in August, 1953, completed the second stage of the reform of the International Code for Zoological Nomenclature, of which the first stage was carried through by the Thirteenth Congress at Paris in 1948. The crowded days of international congresses and the short duration of such meetings do not lend themselves readily to the detailed discussion of subjects such as zoological nomenclature, in which many of the problems involved are highly complex and, in addition, potentially controversial. For, unless special steps are taken, there is not time for adequate discussion, nor can there be any guarantee that zoologists in those countries which are situated at a distance from the seat of the congress will be properly represented. Moreover, for the discussion of zoological nomenclature, the preliminary circulation of adequate documentation is essential. It was with these considerations in mind that the International Trust for Zoological Nomenclature, the incorporated body which manages the business affairs of the International Commission on Zoological Nomenclature took a series of measures designed to ensure that the Copenhagen Congress should have the best possible chance of achieving success when it came to complete the revision of the International Code. First, the Trust early in 1952 published a special volume (Vol. 7) of the *Bulletin of Zoological Nomenclature* entirely devoted to the discussion of the major problems of zoological nomenclature which had been deferred by the Paris Congress (1948) for further study and for submission to the Copenhagen Congress. In response to the appeal for advice contained in the foregoing volume, large numbers of comments were received in the course of 1952 from representative zoological institutions and individual specialists both in the Old World and the New. These comments, together with the documents relating to all other matters affecting zoological nomenclature on which proposals had been received, were then published in the *Bulletin*, two complete volumes (Vols. 8 and 10) being reserved for this purpose. The second phase of the preparations undertaken by the Trust consisted in the organization, with the assistance of a grant from the International Union of Biological Sciences, of a Colloquium on Zoological Nomenclature to meet at Copenhagen a week before the opening of the Congress for the purpose of discussing in detail the documentation collected by the Trust. The invitations to this Colloquium—about 150 in number—were issued by the Trust in March, 1953. These invitations were, in part, addressed to representative zoological institutions which were asked to nominate representatives, and in part, to individual zoologists who were known, through having corresponded with the International Commission, to be interested in zoological nomenclature. In view of the fact that the Rules of Zoological Nomenclature are as important to paleozoologists as to neontologists, a special effort was made to secure the presence at the Colloquium of representatives of paleontological institutions and of individual paleozoologists, this being necessary since normally few paleontologists attend International Zoological Congresses in addition to the International Geological Congresses. As the result of these efforts, the Colloquium, when it assembled, consisted of about fifty members, divided almost equally between the Old World and the New. The largest single representation was from the United States. The Colloquium met every day for a week, and by the eve of the opening of the Congress had completed its examination of the long agenda of seventy items which had been submitted to it, and had reached conclusions on each of those items, with the exception of that relating to the suggested introduction into the Code of an article recognizing the principle of conservation. During the week of the Congress itself, a draft report was prepared, and this was examined at two meetings held on Monday, August 10, jointly with the International Commission and the Section on Nomenclature. At the conclusion of the second of these the report, as amended in discussion, was adopted by the Colloquium and at once submitted to a specially convened meeting of the International Commission. The Commission, which had participated in the discussions of the Colloquium, thereupon approved and adopted the report of the Colloquium, which it annexed as an appendix to its own report to the Congress. The two reports were approved and adopted by the Section on Nomenclature at a meeting held jointly with the Commission and the Colloquium on the morning of Wednesday, August 12, and were unanimously approved and adopted by the Congress in concilium plenum on the same afternoon.

The subjects dealt with by the Congress—and studied initially by the Colloquium—were of two kinds: (1) the reform of the Code of Zoological Nomenclature; (2) the organization of the International Commission and the financial problems confronting the Trust in its task of providing the finance required for maintaining the work of the Commission. The study of the Code was itself twofold in character, the first portion being concerned with certain major problems remitted to the Copenhagen Congress by the Paris Congress of 1948, the second, with a large number of miscellaneous proposals received since the Paris Congress and some of them designed to secure the reversal or modification of individual decisions taken by that Congress.

The problem which figures first in the report of the Colloquium and the Section, and on which the largest amount of time was spent, was concerned with the devising of means for promoting stability and uni-

versality in zoological nomenclature. The first measure taken was to introduce a preamble to the Code stressing that the foregoing is one of the principal objects for which the Code exists. Second, provisions were adopted to remove the threat to stability represented by dormant *nomina dubia*. Third, provisions were inserted in the Code for the restriction and designation of localities for nominal species, the lack of provisions relating to which has, in the past, been a cause of much confusion in the nomenclature of polytypic species. Finally, extensive consideration was given to various proposals for the recognition in the Code of the Principle of Conservation, that is, the introduction of a provision to protect well-established names from the risk of being overthrown by unknown or virtually unknown names of older date. This was the one subject on which no definite decision had been reached by the Colloquium before the opening of the Copenhagen Congress. During the Congress this problem was discussed first at a specially convened plenary session and later at a meeting held jointly between the Section, the International Commission, and the Colloquium at which a restricted scheme was adopted by a large majority. Closely connected with the problem of stability is that of the recognition of neotypes as a category of type specimen, on which provisions were adopted for cases where the original type material of a species has been lost or destroyed. The third and fourth of the principal subjects referred to the Copenhagen meeting were concerned with the naming of units belonging to the Family Group and of units belonging to the Order/Class Group and higher taxonomic categories, respectively. In the case of Family-Group names a comprehensive scheme was introduced in place of the wholly inadequate provisions (Articles 4 and 5) of the present Code. In this scheme room was left for further consideration of the proposals for uniform endings proposed by Stenzel and others, this subject being remitted for decision by the International Commission upon the receipt of a report from a committee of specialists. The main feature of the provisions adopted for the naming of Orders and higher groups was that such names as those for units of lower categories shall be defined by the type method, the type unit adopted being the type genus. The Congress accepted the view that it was now too late to insist upon uniform endings for names belonging to this group and decided that the duty of fixing types for, and of recommending the acceptance of, existing names should be remitted, in the first place, to specialist committees, whose duty it will be to report to the International Commission. The proposals of these committees will then be published in the *Bulletin of Zoological Nomenclature,* and a prescribed period allowed for the receipt of comments from interested specialists before final decisions are taken by the Commission and the names so approved placed upon "Official Lists." Finally in this sector, the Congress completely revised the provisions (Article 19) relating to the emendation of generic and specific names. The revised provision greatly simplifies the rules in this matter and reduces the area within which emendations are permissible, this object being attained at the cost of a disregard of considerations of an etymological and similar character. Of the decisions on other problems affecting the Code-special mention must be made of the following: (1) Recognition is to be withdrawn at an early prescribed date from names originally published in synonymies, but protection is to be given to such names when already well established. (2) Words are to be added to Proviso (e) to Article 25 providing that, to secure a status of availability, a specific name published after December 31, 1930, must have been accompanied by a statement in which the author of the name attempted to indicate the characters which he regarded as being diagnostic for the species so named. (3) The distribution of microfilms, microcards, and the like is banned as a method of "publishing" new zoological names. (4) The decision taken in Paris on the subject of page precedence is revoked, the First Reviser principle for determining the relative precedence to be accorded to names published in the same book and on the same date being re-established, with a definition of what constitutes selection by a first reviser and a "Recommendation" that, other things being equal, the principle of page precedence should, in future, be followed by authors when acting as first revisers. (5) Provisions have been adopted to prevent irresponsible persons from needlessly invalidating specific names by making them junior secondary homonyms by uniting genera in a manner regarded by specialists in the groups concerned as being unjustified on taxonomic grounds.

Special interest attaches to the adoption by the Copenhagen Congress, on a number of occasions, of a novel device designed at the same time to provide flexibility and to promote stability, while leaving the processes of nomenclature as automatic as possible. The feature of the procedure so adopted is the grant to individual specialists of the right to make exceptions to certain of the rules, in the interests of stability, through the communication to the Commission, for publication in the *Bulletin,* of notices giving references to papers containing proposals of this kind, such departures from the ordinary rules becoming provisionally effective immediately upon the publication of the notice relating to them. In every case of this kind provision is made for a specified period during which the action referred to in such a notice will be open to challenge by interested specialists. The departure from the ordinary rule will become definitive only if no protest is lodged during the prescribed challenge period; wherever challenges are made, the case will go to the Commission for final decision.

The rules governing the composition and procedure of the International Commission on Zoological Nomenclature, on which various suggestions had been received, were also carefully examined. In general, the conclusion reached was that the present arrangements are satisfactory and do not call for any change; certain changes were, however, made in the method to be

followed in seeking nominations of candidates for election to the membership of the Commission. These changes have as their purpose the obtaining of candidates with high qualifications, if necessary, at the expense of the geographical distribution of seats as between one country and another. As regards the financial position, a warning was given to the Congress by the Right Hon. Walter Elliot, the Chairman of the Trust, that it was essential that the zoologists of the world should devise a scheme which would provide the requisite minimum income if they wanted the Commission to continue in existence. The Trust possessed no assured income and had to rely almost exclusively upon the income that it could obtain from the sale of publications to cover not only printing costs but also the unavoidable expenses of the Secretariat of the Commission. Mr. Elliot added that even the income so secured amounted to less than half that which would be required if the Secretariat were organized on a commercial basis and did not enjoy the services provided free of charge by the present Honorary Secretary. The gravity of the position disclosed by Mr. Elliot's statement created a deep impression, and a committee was at once appointed under the chairmanship of Professor R. Spärck, the President of the Congress, to devise a new financial plan.

In accordance with a suggestion made by the Colloquium and endorsed by the International Commission and by the Section on Nomenclature, the Congress at its final concilium plenum adopted a resolution advising zoologists to guide themselves in their work in the light of the decisions taken in Copenhagen as soon as these were officially published, even though those decisions would not formally come into force until the publication, some time hence, of the revised text of the Code, as amended at Copenhagen. In order to assist zoologists in taking the advice so offered by the Congress, the International Trust, in agreement with the Congress, in arranging for the early publication (probably at the end of December) and at a low price (75 cents) made possible by the diversion to this purpose of a part of the Trust's slender reserves, of the Official Record of the decisions on zoological nomenclature taken by the Congress. As already explained, the document so to be published is the report of the Colloquium which, on the recommendation of the International Commission and of the Section on Nomenclature, was unanimously adopted at the concluding plenary session of the Congress.

FRANCIS HEMMING

Secretary to the International Commission on Zoological Nomenclature, Chairman of the Colloquium on Zoological Nomenclature Copenhagen, 1953

28 Park Village East,
Regent's Park, London, N.W.1.

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Book Reviews

Histology. 2nd ed. Arthur Worth Ham. Philadelphia–London: Lippincott, 1953. 866 pp. Illus. + plates. $10.00.

Histology and related fields have been advancing so rapidly that Dr. Ham felt it necessary to issue a new edition of his widely used textbook only three years after its first appearance. This second edition includes a number of major changes. The sections on histological techniques have been expanded and brought up to date, and electron microscopy has been particularly emphasized. The chapter on the cell has been almost completely rewritten, and other chapters or sections that have undergone considerable revision are those on intercellular substances, the cells of the blood, the connective tissues proper, bone, muscle, nervous tissue, the circulatory system, liver, lung, kidney, pituitary, and adrenal. The inclusion of some 144 new illustrations should prove of great value to the student. The general quality of the illustrations is high. A few photomicrographs, however, are not reproduced with the clarity or contrast that one would desire, giving the impression that they were not made from first-rate preparations.

The author has performed a novel service for beginning students in his four opening chapters. This part of the book, which covers some 40 pages and includes 27 figures, presents the elements of histological techniques, both ordinary (fixation, embedding, sectioning, staining, mounting) and special (study of fresh tissue, phase microscopy, electron microscopy, etc.) and attempts to orient the student in the use of the microscope and the proper study and interpretation of histological sections. As an attempt at this important and difficult task, these chapters are praiseworthy. If the author appears at times to descend to banality, it must be remembered how untutored most beginning medical students are in the elements of histological techniques and in the use of the microscope.

The main body of the text is eminently readable and authoritative. An effort is made to present the different views on disputed or unsettled problems, which should be stimulating to the good student if disturbing to the mediocre or poor one. As is inevitable in books of this sort, the quality of the chapters varies. The best ones are probably those that represent the particular interests of the author. The references to the literature at the end of each chapter have been carefully selected; they should be of value to other than the beginning student.

I wish to emphasize that Dr. Ham's textbook, which is one of the most recent in the English language, is one of the very best. It deserves, and undoubtedly will continue to enjoy, great popularity.

In closing, however, I would like to discuss one point that relates not to the basic merit of the book but to its pedagogical outlook. The book is heavily slanted toward pathology and contains frequent excursions into the problems of cancer and other diseases. This is in line with the author's statement in the opening chapter that "in this book no pains will be taken to exclude any reference to the abnormal; indeed, every effort will be made to introduce enough histopathology to help the student to associate and correlate these two subjects [histology and pathology] as much as possible" (p. 7). I recognize that there are different views about the teaching of the human anatomical sciences. But I happen to be one of those who believe that histology is not the handmaiden of pathology; no more, indeed, than gross anatomy is the lackey of surgery or embryology the midwife of obstetrics. There are such things as first things; although, in the mad pedagogical whirl of today, this simple fact is too often lost sight of. I realize, for example, that one cannot properly teach the histology and cytology of the pancreas without reference to diabetes mellitus, but such reference is properly dictated and modified by the aim toward understanding *normal* pancreatic structure and function. The wisdom of distracting the attention of the beginning student with the problems of disease, however, is seriously to be questioned. One would be equally justified in attempting to teach surgical procedures in the first-year dissecting room; indeed, such attempts, unfortunately, are not unknown. Such digressions may serve temporarily to inflate the ego of the poorer medical student, but they do not fool the really good one. In addition, they cause the teacher deliberately to forfeit the last opportunity to give the student an understanding of the normal human body by focusing his attention elsewhere. The normal must be studied and appreciated before the abnormal; hence, at the beginning the latter had best be deliberately put aside wherever possible.

WILLIAM L. STRAUS, JR.
Laboratory of Physical Anthropology
The Johns Hopkins University

A List of the Names Proposed for Genera and Subgenera of Recent Mammals. From the publication of T. S. Palmer's *Index Genera Mammalium* 1904 to the end of 1951. L. R. Conisbee. London: British Museum (Natural History), 1953. 109 pp. 1£.

Palmer's *Index Genera Mammalium* (1904) has long been out of print. It is still so useful to the mammalian systematist that the very few copies appearing in the market command a large premium, but it is obviously now long out of date and therefore very incomplete. Mr. Conisbee has painstakingly completed it through 1951 by this excellent supplement. As in Palmer, the supplement gives at least the following essential data for each generic or subgeneric name: author, year, classification (order and family), original reference, type species, type locality, and derivation of the name (when ascertainable). There is also a systematic list of names following the main, alphabetical listing. The work is accurate and nearly exhaustive. It is indispensable for those fortunate enough to have a copy of Palmer and helpful to anyone interested in zoological nomenclature. Its usefulness is, nevertheless, limited by the fact that it omits names of extinct genera and subgenera and that it is a supplement to a practically unobtainable work. What we still need is a complete new edition of Palmer.

Such a list arouses some thoughts on the progress and status of systematic mammalogy. A large sampling of its 611 generic and subgeneric names indicates that only about 25 percent of them were applied to newly discovered species, and even in those instances there is usually reason to challenge the author's opinion that generic or subgeneric distinction of the then new species was warranted. Some 60 percent of the names were applied to groups already well known but not earlier given subgeneric or generic rank. Nomenclatural inflation may be inevitable and may even be occasionally useful, but it does little or nothing to increase zoological knowledge. About 10 percent of the names from the start were invalid on purely nomenclatural grounds. So large a proportion of debris suggests an actual decline in knowledge or, at least wisdom. A final five percent, more or less, of the listed names were substitutes for previous names found invalid on nomenclatural grounds—attempts to clear up still older debris.

G. G. SIMPSON
Department of Geology and Paleontology
The American Museum of Natural History

New Books

Adaptation in Micro-Organisms. Third Symposium of the Society for General Microbiology, London, April, 1953. R. Davies and E. F. Gale, Eds. New York: Cambridge Univ. Press, 1953. 339 pp. Illus. + plates. $6.00.

Cultural Patterns and Technical Change. Manual prepared by World Federation for Mental Health; Margaret Mead, Ed. Paris: Unesco, 1953. U.S. distr.: Columbia Univ. Press, New York. 348 pp. $1.75.

International Review of Cytology, Vol. II. G. H. Bourne and J. F. Danielli, Eds. New York: Academic Press, 1953. 545 pp. Illus. $11.00.

Chemical Methods in Industrial Hygiene. Frederick H. Goldman and Morris B. Jacobs. New York: Interscience, 1953. 274 pp. Illus. $3.75.

Procedures in Experimental Metallurgy. A. U. Seybolt and J. E. Burke. New York: Wiley; London: Chapman & Hall, 1953. 340 pp. Illus. $7.00.

Augustine to Galileo. The History of Science A.D. 400–1650. 1st American ed. A. C. Crombie. Cambridge, Mass.: Harvard Univ. Press, 1953. 436 pp. Illus. + plates. $8.00.

Frontal Lobes and Schizophrenia. Second lobotomy Project of Boston Psychopathic Hospital. Milton Greenblatt and Harry C. Solomon, Eds. New York: Springer, 1953. 425 pp. Illus. $12.50.

Surgery of the Biliary Tract, Pancreas, and Spleen. A handbook of operative surgery. Charles B. Puestow; illus. by Jessie W. Phillips. Chicago: Year Book Publ., 1953. 370 pp. Illus. $9.00.

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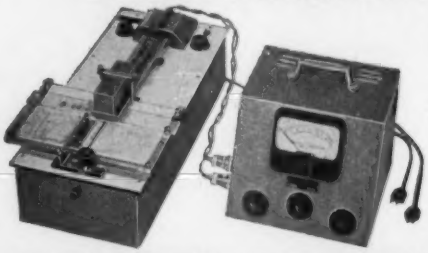

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PRIOR to the organization of the Utah Academy of Science, several natural science societies were formed in Utah. During the period from 1880 to the turn of the century many native Utahans, schooled in the sciences at eastern colleges and universities, along with the science teachers and professional men who were coming into the state, felt the need of a society to strengthen their major interests. In 1882, an Agassiz Chapter was formed in Salt Lake City which began publishing a little journal in 1885, but soon abandoned the project. In 1885 the Scientific Society of Utah was organized and held an annual meeting for several years, after which it was merged with such groups as the Utah Forestry Association, organized in 1894, and the Natural History Society of Utah and the Microscopical Society, both of which were organized in 1895. These organizations were short lived, being dependant on the activities of a few energetic leaders.

The urge to have a permanent state-wide organization culminated in the autumn of 1907, when a call was issued at the Provo meeting of the Utah Teachers Association for all who were interested to attend a meeting on January 3, 1908, for the formation of a Utah Academy of Science. Thirteen scientists responded. Committees on constitution and on membership were appointed.

On April 3, 1908, a meeting was held at which a draft for a constitution was presented and ratified. Ira D. Cardiff of the University of Utah was elected first president of the Academy.

In 1921, at the annual meeting, it was decided to hold an interim, or fall, meeting; thus, on November 25 of that year, the Academy met in Ogden. Since then, two general meetings have been held—the annual meeting in the spring, and an interim meeting in the autumn. At the annual meeting in 1933, the membership voted to enlarge the organization to include the arts and letters. The name was then changed to the Utah Academy of Sciences, Arts and Letters.

The secretaries of the Academy have played an important role, their sundry duties having included the preparation of programs, and the editing and distributing of the Academy proceedings. A. O. Garrett was the first secretary and editor; serving from 1908 until 1924, he gave unstintingly of his time and energy to promote the interests of the Academy. In 1917, he published Volume I of the *Transactions* (223 pp.) and, in 1921, Volume II (276 pp.). C. Arthur Smith became secretary in 1924, and J. Cecil Alter in 1926. In 1928, Vasco M. Tanner was elected secretary, a position which he held until June, 1938; during this period he edited 11 volumes of the proceedings (1900 pp.). He was succeeded by Thomas C. Adams, who edited three volumes (340 pp.). From 1941 to 1951, I. O. Horsfall was secretary and was responsible for 10 volumes, (1236 pp.). Mrs. G. L. Harrison is the present secretary; her ability as an editor is reflected in the excellent appearance of the two volumes of the proceedings which she has produced.

This organization has grown until it is now an influential society of 312 members. The officers and members have initiated and fostered many important programs such as the conservation of the state's natural resources, biological surveys, improvement of school science teaching, and the promulgation of research in the sciences, arts, and letters.

The present staff of officers of the Academy, 1953–1954, is an efficient active group. Bertrand F. Harrison of the Brigham Young University is serving as the 46th president. The vice-president is Lincoln Ellison of the Intermountain Forest and Range Experiment Station. The secretary and editor is Mrs. Gladys L. Harrison of the Agricultural Experiment Station, Logan, Utah. Members of the Council are D. Elden Beck, Brigham Young University; Joseph A. Geddes, Utah State Agricultural College; Joseph K. Nicholes, Brigham Young University; and Dilworth Walker, University of Utah. The Academy representative on the AAAS Council is Eldon J. Gardner, Utah State Agricultural College.

The members of the Academy are pleased to be affiliated with the AAAS and have expressed a desire to support the Association in every way possible.

VASCO M. TANNER

Brigham Young University
Provo, Utah

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Australian and New Zealand Association for the Advancement of Science. Report of the 29th Meeting, Sydney, August 1952. J. F. Kefford, Ed. Sydney, Australia: A&NZAAS, 1953. 386 pp. Illus.

Basic Body Measurements of School Age Children. A handbook for school officials, architects, and design engineers in planning school buildings, furniture, and equipment. W. Edgar Martin. Washington 25, D.C.: U.S. Department of Health, Education, and Welfare, 1953. 74 pp. Illus. Free on application to the School Housing Section, Office of Education.

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Fourth Annual Report of the Commonwealth Scientific and Industrial Research Organization for the Year Ending June 30th, 1952. Canberra, Australia: L. F. Johnston (for the Government of the Commonwealth of Australia), 1953. 173 pp. 10s.

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Notes on Flycatchers of Genus* Batis.** Fieldiana: Zoology, Vol. 34, No. 10. Austin L. Rand. 16 pp. 35¢. ***A Colombian Race of* Tinamus osgoodi.** Vol. 34, No. 18. Emmet R. Blake. 2 pp. 15¢. ***A New Fruit Pigeon from Nepal. Vol. 34, No. 19. Austin L. Rand and Robert L. Fleming. 2 pp. 15¢. Chicago, Ill.: Chicago Natural History Museum, 1953.

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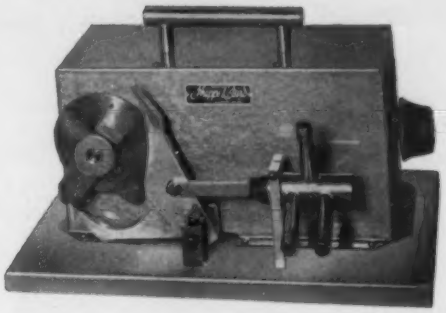

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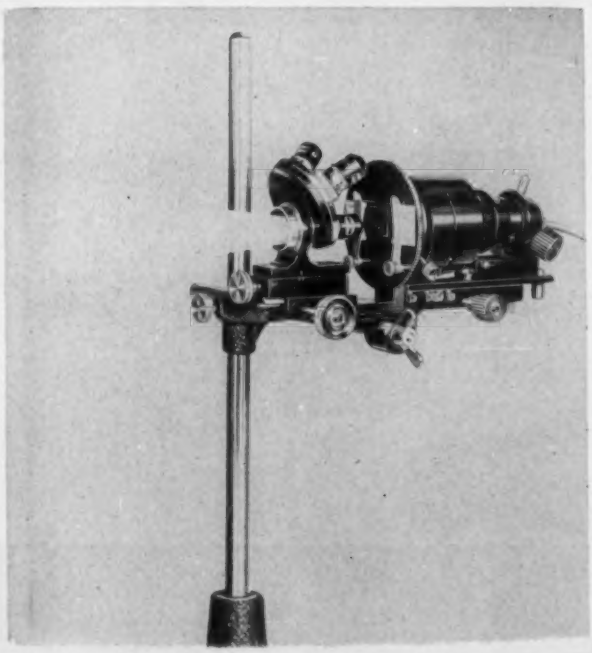

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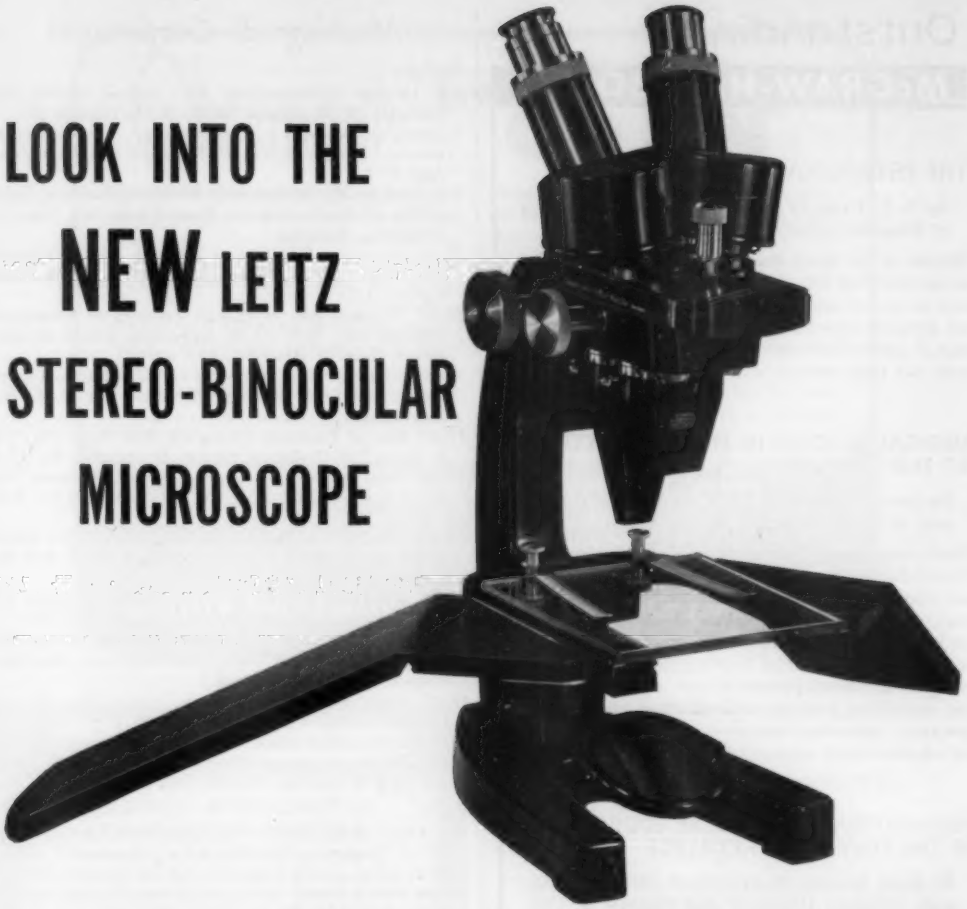

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7. Assoc. for Research in Ophthalmology, Midwest Section annual, Chicago, Ill. (F. W. Newell, 950 E. 59 St., Chicago 37.)

8–9. Conf. on Marine Corrosion Problems, Berkeley, Calif. (Dept. of Conferences and Special Activities, Univ. of California, Berkeley.)

13–14. American Educational Research Assoc., Atlantic City, N.J. (F. W. Hubbard, 1201 16 St., NW, Washington, D.C.)

14–16. National Soc. of College Teachers of Education, Atlantic City, N.J. (C. E. Eggertsen, School of Education, Univ. of Michigan, Ann Arbor.)

15–18. American Inst. of Mining and Metallurgical Engineers, New York City. (E. H. Robie, 120 E. 41 St., New York 17.)

15–18. Soc. of Economic Geologists, New York City. (O. N. Rove, U.S. Geological Survey, Washington 25, D.C.)

15–20. Latin American Cong. of Physical Medicine, Medellin, Colombia. (C. L. de Victoria, 176 E. 71 St., New York 21, N. Y.)

19–25. International Management Cong., 10th, São Paulo, Brazil. (P. S. M. Phillips, Management House, Hill St., London W. 1, Eng.)

20–21. American College of Apothecaries, Chicago, Ill. (R. E. Abrams, 2173 Knorr St., Philadelphia, Pa.)

25–27. American Acad. of Forensic Sciences, Chicago, Ill. (R. Turner, Dept. of Police Administration, Michigan State College, East Lansing.)

26–27. American Physical Society, Austin, Tex. (K. K. Darrow, Columbia Univ., New York 27.)

28–4. Pan American Assoc. of Oto-Rhino-Laryngology and Broncho-Esophagology, Mexico City, Mex. (C. L. Jackson, 1901 Walnut St., Philadelphia 3, Pa.)

March

4–5. American Soc. for Metals, mid-winter, Boston, Mass. (W. H. Eisenman, 7301 Euclid Ave., Cleveland 3, Ohio.)

6. Symposium on Air Pollution and Its Control, 2nd annual, Staten Island, N. Y. (N. Colosi, Wagner College, Staten Island, N. Y.)

8–9. National Symposium of Division of Organic Chemistry, Chemical Inst. of Canada, Montreal, Canada. (G. E. McCasland, Dept. of Chemistry, Univ. of Toronto, Toronto, Ont.)

8–10. American Inst. of Chemical Engineers, Washington, D.C. (S. L. Tyler, 120 E. 41 St., New York 17.)

8–10. The Wildlife Soc., annual, Chicago, Ill. (G. A. Petrides, Dept. of Fisheries and Wildlife, Michigan State College, East Lansing.)

9–12. American Mosquito Control Assoc., annual, Atlantic City, N.J. (R. E. Dorer, 301 Essex Bldg., Bank & Plume Sts., Norfolk, Va.)

11–13. American Orthopsychiatric Assoc., New York, N. Y. (M. F. Langer, 1790 Broadway, New York 19.)

11–13. Kappa Delta Pi, Lafayette, Ind. (E. I. F. Williams, 277 E. Perry St., Tiffin, Ohio.)

11–13. National Wildlife Federation, annual, Chicago, Ill. (L. F. Wood, 232 Carroll St., NW, Washington 12, D. C.)

15–19. National Assoc. of Corrosion Engineers, annual, Kansas City, Mo. (A. B. Campbell, 1061 M & M Bldg., Houston 2, Tex.)

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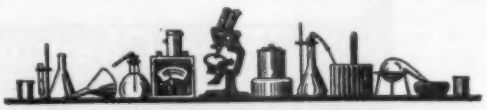

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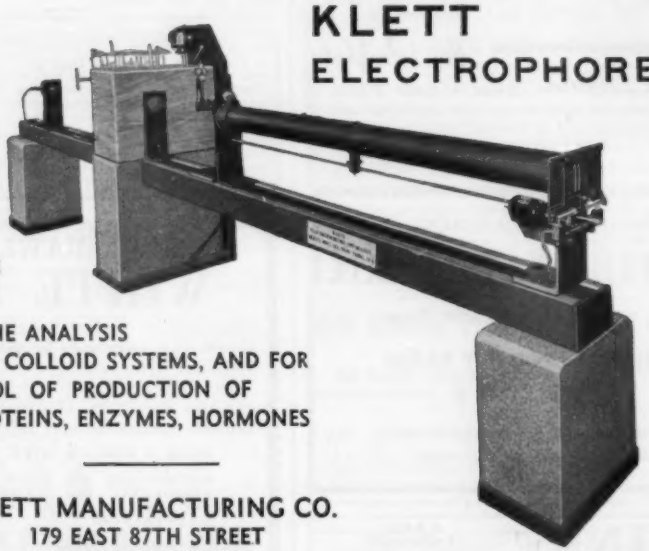

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